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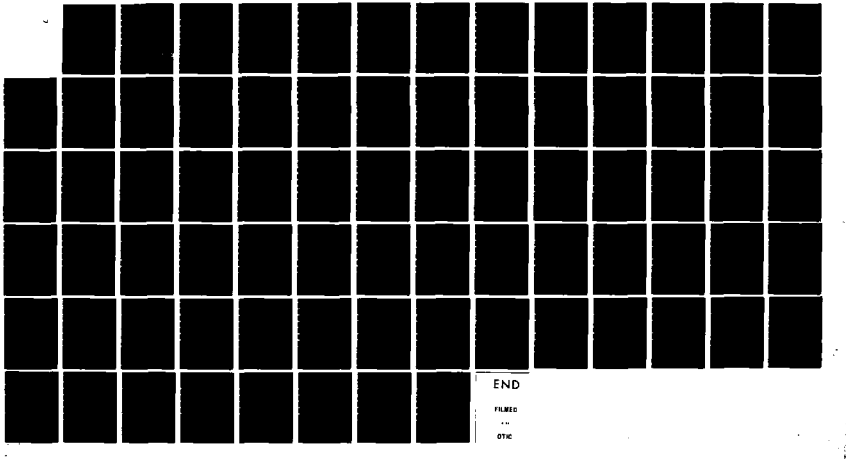

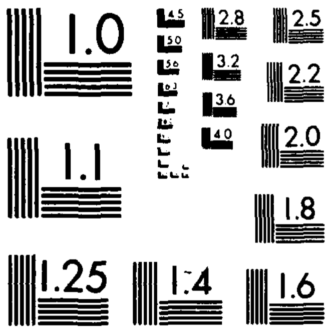

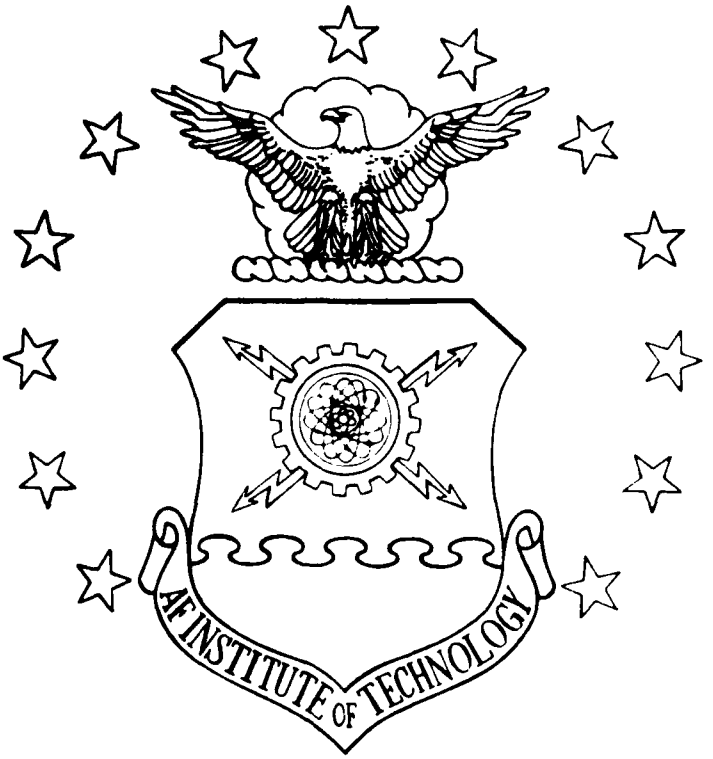

AN EVALUATION OF TWO RELIABILITY AND MAINTAINABILITY INFORMATION SYSTEMS

Larry K. Bock, Captain, USAF

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DEPARTMENT OF THE AIR FORCE
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Air Force managers require adequate and timely information in order to make effective decisions regarding reliability and maintainability (R&M) issues. Since 1980, at least two Air Force organizations have contracted for additional computer data base systems to improve their R&M data requirements. These data base systems provide real-time maintenance and operational data on certain weapons systems. This study analyzed the output characteristics of these new data base systems to determine if they did provide improved information and comparison with the standard Air Force maintenance and operational data reports. It was shown that the two new data base systems did provide more timely R&M data which resulted in information that allowed for effective and efficient managerial decision making. However, all the timely information available for managerial decisions will be hindered until data input errors are reduced.

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information are contained therein. Furthermore, the views expressed in the document are those of the author(s) and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the United States Air Force, or the Department of Defense.

LSSR 66-83

AN EVALUATION OF TWO RELIABILITY AND MAINTAINABILITY INFORMATION SYSTEMS

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirement for the

Degree of Master of Science in Logistics Management

By

Larry K. Bock, B.S.
Captain, USAF

January 1984

This thesis, written by

Captain Larry K. Bock

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

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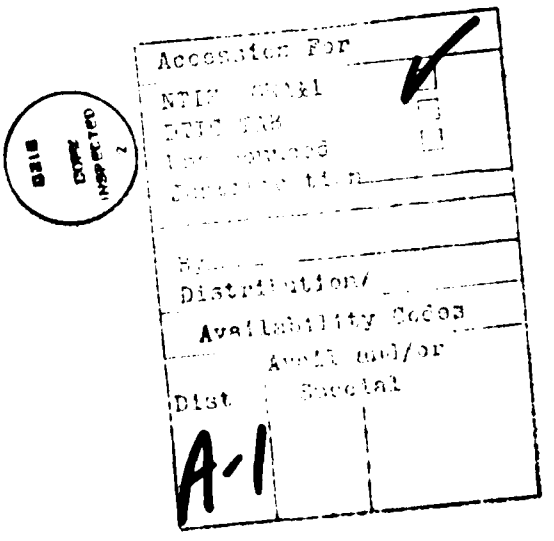
-Larry K. Bock



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CHAPTER I

INTRODUCTION

Background

In this age of high technology, the key to effective management is the ability to obtain and use vast amounts of information. The arrival of computers and modern communication capabilities has resulted in quantities of data being available at a very rapid pace. In order to properly use this enhanced management capability, the user needs to have an information system which meets his requirements at the proper time. However, a manager could be rapidly inundated with vast amounts of data, much irrelevant, which could hamper decision making as much as before. The key, then, is to be able to obtain the proper quantity and quality of data at the right time resulting in information which allows more effective decision making.

Having limited resources available in today's Air Force, the emphasis is to develop and field weapon systems which meet support and readiness requirements. To ensure these weapon systems meet such requirements, it is necessary to obtain, store, analyze and evaluate system performance in a timely manner. The Air Force accomplishes this by utilizing numerous computers and data collection methods.

The Maintenance Data Collection (MDC) system is the present management system the Air Force uses to monitor equipment/system performance. Basically, the MDC system records and reports the how, what, and when of the maintenance work performed on all aircraft, missiles, ground communications, electronics, meteorological equipment, and related end items. Maintenance action data is documented manually, collected centrally, keypunched and processed for computer storage and manipulation (2:4). Some form of optional maintenance action reporting has been ongoing since 1955. After 1958, mandatory reporting of the MDC system was required by AFM 66-1 (2:6). As a result of this mandatory reporting, the data collection effort was further changed in 1965 to the present MDC system.

Since the decision for mandatory reporting, the actual collection and reporting became a herculean effort. This led to a drop in reporting factors such as work force employment. This reduction in reporting procedures left the MDC system as it exists today. Although the Air Force has used the current MDC system since 1965, it has received constant criticism over the years. An increased emphasis on reporting the data rather than how the data could be used has been an area of criticism since the 1958 mandatory reporting went into affect. Other criticisms and problems of the MDC system are shown in Table 1.

The basic concern over the current MDC system, as for any data base system, is the users are not receiving the information they need to support managerial decision making.

> In regard to MDC, it has been stated: . . . the most telling criticis is that the MDC system doesn't really provide the manager information at all, it just provides reformatted data (2:12-13).

Actually, the MDC system collects maintenance data from all Air Force bases into a computer system which aggregates that data and then produces fixed paper formatted reports. From these reports the data can be analyzed only by manual extraction, preparation and presentation to managers for facilitating any decision process. By the time these presentations are available to management, the information can be several weeks or months old.

As a result of the criticisms and problems relating to the overall usefulness and effectiveness of the MDC system and the reports generated from it, several users of the MDC system data have developed additional computer resources to assist them in their informational requirements. Presently, two system program offices (SPO) in Aeronautical Systems Division at Wright-Patterson Air Force Base have utilized additional computer resources.

Table 1. Summary of MDC System Problems (2)

	ACCURACY	RELIABILITY	ACCESSIBILITY	USABILITY	EFFICIENCY
INPUT	Data coding too complex; voluminous manual recording; personnel training inadequate; pressures for padding data.	Individual motivation lacking; data coding unclear.	Data not collected; or not available for collection; data sources unknown; collection of related data not synchronized in time; lag too great between capture and entry.	Lag too great between capture and entry.	Complex procedures; methods not appropriate to volume; outdated equipment & procedures.
PROCESSING	Missing or outdated decision rules.	Transmission procedures foster errors.	Hardware and software insufficient to meet needs.	Transmission procedures result in delays.	Processing too slow; too many people & steps involved.
OUTPUT	Degree and frequency of inaccuracy excessive; inadequate controls; and feedback from management on effects.	Conflicting information from different sources; accuracy of input data questionable; info not timely.	Reports not timely for decision making; turn around time on info requests too long; complex procedures for obtaining info; info from different sources not meshed.	Not in format required for subsequent action; appropriate programmable analyses are not provided; perceived reliability low; user acceptance poor; personnel not trained to use info.	Reports not used; inefficient communication channels; re-aggregation and summarization required; manual analyses required.

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Difference Between Data and Information

To provide a common frame of reference, the following terms are defined as they are used in this thesis:

Data. A representation of facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing by humans or machines (5:571).

Information. (1) data that has been transformed into a meaningful and useful form for specific human beings; (2) the meaning that a human assigns to data by means of the known conventions used in their representation (5:575).

Statement of the Problem

The current emphasis in the defense establishment are support and readiness. With increased use of highly technological and expensive weapon systems, the emphasis is on the support and readiness of these systems. As stated in a DOD joint agreement in June 1983 (13):

> Improvements in support and readiness are major DOD objectives in both the weapon system and support technology areas. Technical innovation is essential to improve the readiness of our systems. We agree to increase the emphasis on technology areas which can increase mission reliability, reduce dependence on support equipment, spares and repair facilities, and reduce the need for highly skilled personnel.

The key to meet the support and readiness issue is to have reliability and maintainability (R&M) in the Air Force weapon systems. Through reliability a weapon system has a

high probability of completing its mission without failing. However, when a system does fail it is important to have the capability to quickly repair and maintain it. So support and readiness objectives are dependent upon a weapon system's reliability and maintainability characteristics. The MDC system is one tool which the Air Force uses to monitor weapon system R&M. Headquarters Air Force Logistics Command (AFLC) has the responsibility (16:3):

> In coordination with the command having PMR (Program Management Responsibility) and using commands, determines the data required to realistically measure reliability, maintainability safety and logistics support costs of operational systems.

AFLC establishes a program including management controls to ascertain that each system fielded by the Air Force achieves its R&M requirements. Included in this program is the MDC system. Further responsibilities of AFLC regarding reliability and maintainability are:

1. Establish and maintain a management information system keyed to work unit codes and based on operations and maintenance data to reflect the degree of achieved R&M for operational systems in operational R&M terms.

2. Establish and maintain a R&M performance feedback system to support the effective design, support, and production of new systems.

3. Furnish appropriate R&M management and data products for operational systems in operational R&M terms to

the implementing command, . . ., and the operating command (14:6).

The management information system which AFLC has today consists of two data areas: maintenance and operations. The system to provide the maintenance data portion is obtained from AFR 66-267, Maintenance Data Collection (MDC) System (15). The operational data is obtained from AFR 65-110, Operational Status and Utilization Data G033 B Reports (12). Both the maintenance and operational data are submitted monthly and inputted into AFLC computers which then generate the fixed formatted reports. The reports dealing principally with equipment or system operational effectiveness are the AFLC D056 series reports (11). Figure 1 depicts how the different sources of data come together and result in the D056 reports which then are used by different agencies.

Problems exist with these D056 reports for agencies who attempt to use them for reliability and maintainability evaluations or studies. Some of the major problems are:

1. Timeliness. The time a weapon system experiences R&M problems to the time the negative trend shows up in a report could easily vary three to six months (3:6).

2. Data reports are fixed formatted. Most data is aggregated to such a point that it is difficult to determine to which base or location the data refers or if all locations are experiencing R&M difficulties.

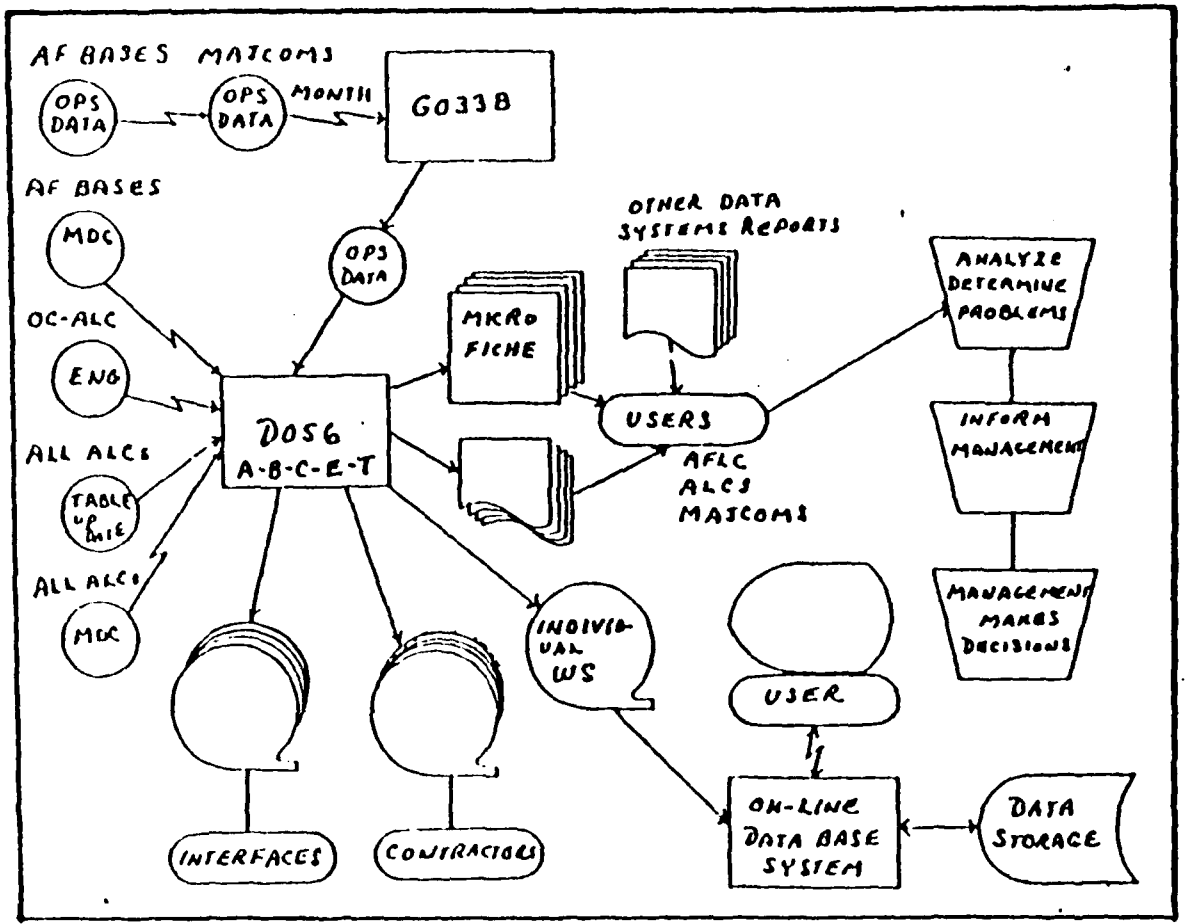


Figure 1. AFLC Current Maintenance and Operations Management Information System (10)

3. Reports do not contain the level of detail necessary to determine what specific equipment or system is causing R&M problems (6).

4. Management information system does not routinely perform automated analysis or trending. Therefore, analysis desired by the R&M engineer must be performed manually. Since this is tedious and intense work, manpower cuts in many organizations has decidely limited analysis of the data (10:7; 1; 3; 6).

5. Current data systems do not produce information in management usable form. Again, the data must be manually prepared for presentation to the management level to facilitate the decision process (10:7).

The present maintenance and operational data reports fail to meet two users' needs in regard to R&M information. They have acquired access to additional computer resources to improve their R&M analysis. The two organizations are the F-16 System Program Office (SPO), and the Strategic Systems SPO, both of the Aeronautical Systems Division (AFSC organization) at Wright-Patterson Air Force Base. This thesis evaluates and compares the R&M products produced by these two additional data base systems. These additional computer data based systems are the MARCON Computerized Data System for the F-16 SPO (MARCON System), and The Analytic Sciences Corporation (TASC) Field Data Tracking System (FDTS) for the Strategic Systems SPO (TASC System).

Scope

This study was concerned with the two computer data base systems (i.e., MARCON and TASC systems) which two ASD program offices are using to support their R&M analysis. No attempt was made to determine if the AFLC report system was, in fact, inadequate in providing R&M information or any information. It was assumed the program offices had adequate requirements for obtaining additional informational support.

Also, no attempt was made to determine if any other users of the AFLC reports were experiencing any problems with content, format or timeliness of the AFLC reports regarding R&M information.

The goal of this study was to determine if the new data base systems are providing a more timely and usable informational product which can aid the manager decision process.

Objectives of the Research

The objective of this thesis is to analyze two new reliability and maintainability (R&M) data base systems being used by two ASD program offices to determine if they provide an improved information system over the present AFLC generated product performance reports. With an improved source of R&M information, the Air Force would be better able to meet its weapon systems support and readiness goals.

A secondary objective was to compare the two systems in

regard to system compatibility. In the last five years, with the rapid advances in computer technology, there exists the problem of the Air Force's increased use of computer systems that lack commonalty. In regard to R&M data bases, it would be beneficial to have the capability to share common R&M information between different weapon systems.

Research Questions

Research questions associated with the research questions are:

1. What are the relative improved performance characteristics of the two new R&M data bases used by ASD?

2. What are the common characteristics of the two new systems?

CHAPTER II

LITERATURE REVIEW

Introduction

Available literature pertinent to this thesis topic centered primarily on the AFLC management information system. There were few documents on the two new data base systems. This is understandable since the AFLC system has been ongoing since the late sixties, while the MARCON and TASC systems have only been operational in the Air Force since 1980-81.

Two research studies and a technical report were generated on the AFLC system by the Air Force Institute of Technology, while the literature covering the newer data systems consisted mainly of contractor reports and Air Force briefings concerning systems capabilities and initial operational goals.

Previous Studies

In August 1967, Major Harold G. Hartley and Captain Richard V. Jamieson (4) wrote a thesis on the use of the Maintenance Data Collection System and its generated reports at the major command level. Previous studies had been conducted at the base level. They did a complete review of the different reports which were created by the MDC system at

that time. They then surveyed the various major commands to determine how effectively the MDC system was being used.

The result of their research showed the MDC system was not being effectively utilized by the major command headquarters (4:71). Their study even indicated the commands were using other sources of information rather than MDC information. They stated,

> Command level personnel utilized reports and communications media that were not integral to the MDC system as the primary means of satisfying their management information requirements (4:70).

Another finding in their study was that command special report requirements most successfully fulfilled the MDC requirements of using commands (4:71). Basically, the command reports provided the timeliness lacking in the MDC formal reports. So, back in 1967, the timeliness issue of the MDC reports was as much a problem as it was in the 1980-81 period which led to the MARCON and TASC systems inception.

In February 1971, Captains Irving L. Hoffman and Robert L. Warddrip (8) completed a student thesis proposing criteria and data for a reliability and maintainability information system. Basically, they tried to arrive at standardized terminology to be used by all organizations dealing with reliability and maintainability issues, after which they developed the criteria and data elements. From their study, they concluded that a reliability and maintainability information system should:

1. provide information on what management needs to know about reliability and maintainability,

2. provide a system for collection of pertinent data, and

3. present the information derived from the data in usable form to support the making of decisions (8:102).

They concluded that R&M information on Air Force operational systems was impaired by a pervading lack of confidence in the information's quality (8:105). They even stated:

> Perhaps we should accept our operational reliability and maintainability information as approximate and use it as an "indicator" only (8:102).

The results of their research indicated a lack of confidence in the quality of data as provided by the MDC system at that time.

Other Sources

In February 1978, Majors Richard V. Badalamente and Thomas D. Clark wrote a technical report on an analysis they conducted on the MDC system (2). They provided a historical review of the problems attributed to the MDC system since its inception in 1955. They categorized these problems (Table 1) as dealing with accuracy, reliability, accessibility, usability and efficiency (2:11). They stated that reporting data rather than the use of information in the decision

process had received the main emphasis in the MDC system.

One of the conclusions of their report was that to have an effective MDC system you needed to ensure the data was transformed into information and effectively used in the decisional structure.

A January 1983 report from The Analytic Sciences Corporation (TASC) reported on the Field Data Tracking System (FDTS) which TASC developed for the Strategic Systems System Program Office (SSSPO) (9). The report discussed the utility of the present FDTS and how the system might expand in the future. Basically, this data system collected additional maintenance data elements in regard to the MDC system and displayed the information in various formats rather than just a fixed format.

Overall, this TASC document reported on one of the new data base systems being used to provide additional R&M information to a program office.

Summary

This literature review has presented the most pertinent documents dealing in the same general area as this research. Most dealt with the problem areas of the current MDC system. However, these documents show the reasoning behind the development of additional computer resources to support R&M data requirements.

CHAPTER III

METHODOLOGY

Overview of Research

The main procedure used to answer the research questions regarding the MARCON and TASC data base systems was to set up a criteria list by which to evaluate the information provided by the two new systems. With this criteria, both systems can be compared on an equal basis in order to determine whether the systems do provide additional information to aid in R&M analysis.

Informational Criteria

The first set of criteria is very general and can be used to assess various elements of information. The following list of criteria was obtained from the Hoffman and Warddrip thesis (8) concerning the criteria and data necessary for an R&M information system.

1. Is the information accurate enough?
2. Is there enough information available to make decisions?
3. Is the information relevant to the decisions which must be made?
4. Is the information capable of being understood by those who must use it?
5. Is the information available when it is needed?

6. Is compatible information available from a secondary source?

7. Is the overall value of the information adequate for decision-making purposes?

Since the criteria listed above is very general, a second list was developed based on the numerous problem areas associated with the MDC system. These problems were covered in Table 1 and other documents discussed in the literature review chapter. The additional informational system criteria are:

8. Cost
   - initial start-up cost
   - yearly continuation costs

9. Type of reports
   - type of format
   - monthly, 3-month average, cumulative, etc.

10. sources of basic data
    - Are there redundant sources to eliminate inconsistencies?

11. storage capability
    - How many years of data can be stored?

12. tracking capability
    - What level of detail can be stored?

13. Does information match user's needs?
    - Are outputs being used?

14. benefits
    - Have decisions improved?
    - Has time been saved?

15. use of the data base
    - Does it cover the whole weapon system or just a specific area?

Nature and Sources of Data

It became quite difficult to collect sufficient data for the assessment of the criteria lists. Since both the MARCON and TASC systems are fairly new (beginning 1980-81), there was very little written documentation regarding informational output capabilities. Only the TASC system had a formal report and it was prepared by the source contractor and not the Air Force. Therefore, the majority of the data collection was accomplished through interviews with personnel in the program offices who deal with R&M matters. Originally, these interviews were to be conducted using a checklist of questions. This checklist was based on a similar checklist used by Hoffman and Warddrip in their research (8). However, once the actual interviews were started the checklist proved to be inadequate to the uniqueness of each data-based system. Each interview was based on questions generated from an earlier research and other interviews. Basically, it was a stepping stone type process leading to additional data and knowledge at each of the data systems.

For the MARCON system, individuals interviewed were Mr Wally Detert, ASD/ENSSR, in charge of the engineering office dealing with R&M (3), and Mr Jeff Anderson, engineer in the F-16 SPO (1). The source for the majority of the data collected on the TASC system was Mr Phil Hermes, ASD/YYEE, R&M engineer in the Strategic Systems SPO (6). Mr Hermes

was instrumental in obtaining the TASC system for the SPO and is the resident expert on all facets of the TASC system.

Data Analysis

Numerical values were assigned to the two data based systems depending on how each met the criteria. If both systems met a particular criteria each were given a one rating. A rating of zero was given if a system did not meet the criteria. However, if one system is more superior than the other, it will be given an additional value of one for a total rating of two.

The 15 criteria areas do not have the same importance regarding R&M factors. Therefore, the 15 areas were separated into three weighted categories based on their importance with each category assigned a different point value. Then based on the numerized total, a conclusion was made on which data base system best met the overall informational objective. The categories, point values, and criteria breakout is as follows:

Category	Point Values	Criteria #
1. Most Important	3 points	3,5,7,9,12,14,15
2. Average Importance	2 points	1,4,8,10,11,13
3. Minor Importanct	1 point	2,6

CHAPTER IV

RESULTS

Introduction

The main objective of this research effort was to analyze two new reliability and maintainability data base systems to determine if they provide improved information over the present AFLC Maintenance Data Collection reports. Achieving this objective was accomplished by using a set of criteria to subjectively compare characteristics of each data base.

A second objective was to observe how compatible the two system's R&M information might be. This objective was accomplished utilizing the same criteria analysis as mentioned above.

An important point concerning the source of basic maintenance and operational data for the two data bases needs to be made at this time. Basically, the MARCON and TASC systems used the same maintenance and operational data as the present AFLC MDC system. The MARCON system does use the exact same D056 data tapes, based on AFTO 349 maintenance reports that the MDC system uses. However, the MARCON system converts the data into timely and usable information, which will be covered in the following analysis section. While the TASC

system used the same data as the MDC system, it obtains it with base computer tapes rather than the D056 data tapes. However, the TASC system goes further than the MDC system and collects all the data available from the AFTO 349 reports, as well as additional data from forms AFTO 95 and SAC 126 (Figure 2). This also will be covered in the following analysis, while examples of these reports are found in Appendix A.

The point made is that the inputs for the MARCON system are the same as those for the MDC system, while those for the TASC system are much more detailed than those for the MARCON and MDC systems.

Analysis

The analysis was conducted along the criteria lines set up in the previous chapter for the MARCON and TASC systems (first, the general, then the additional criteria). The sources for the information were the respective program offices: for MARCON, the F-16 SPO, and for TASC, the Strategic Systems SPO, unless otherwise indicated.

General Criteria.

1. Accuracy. The MARCON system's accuracy is comparable to the MDC's, as they both use the same inputs as mentioned earlier, while TASC is more accurate since it uses additional data with some of the data being redundant, thereby helping to eliminate inconsistencies (9:2-6).

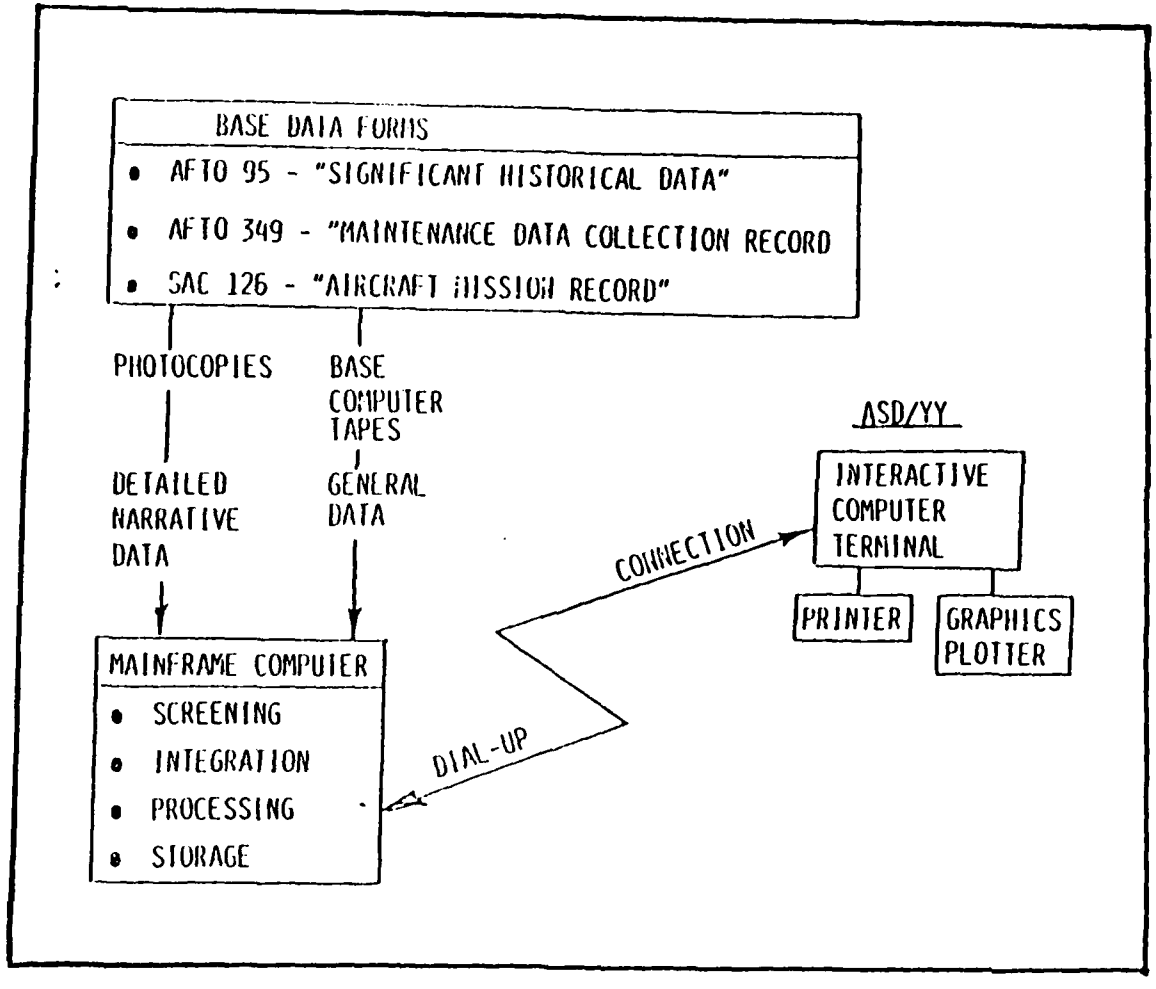


Figure 2. TASC System Flow Chart (6)

2. Quantity. MARCON and TASC systems were the same in this area. Both provided almost unlimited ways to utilize the data for decision-making support.

3. Relevance. The information showed itself to be relevant in both the MARCON and TASC systems due to their timeliness. Each system has the capability to generate "what if" exercises at will, once the input data has been loaded. Neither system is restricted by fixed formats such as the MDC reports.

4. Simplicity. The MARCON or TASC systems can produce several types of graphs which can represent trends or other types of information. The graphs convey information more effectively than pages full of figures.

5. Timeliness. The time required to input the basic data into the two newer systems is roughly the same with the MDC (i.e., 30-60 days after the event). However, once MARCON and TASC systems are inputted with the latest data, any type of informational reporting is available, whereas the MDC can only supply pre-requested information. Both the MARCON and TASC systems have real-time retrievability in obtaining information (See Figure 2 for TASC flow chart). Any special request for data in the MDC system requires additional time for extraction of the information.

6. Compatability. Only the TASC system has a redundant or secondary source. As shown in Figure 3, the

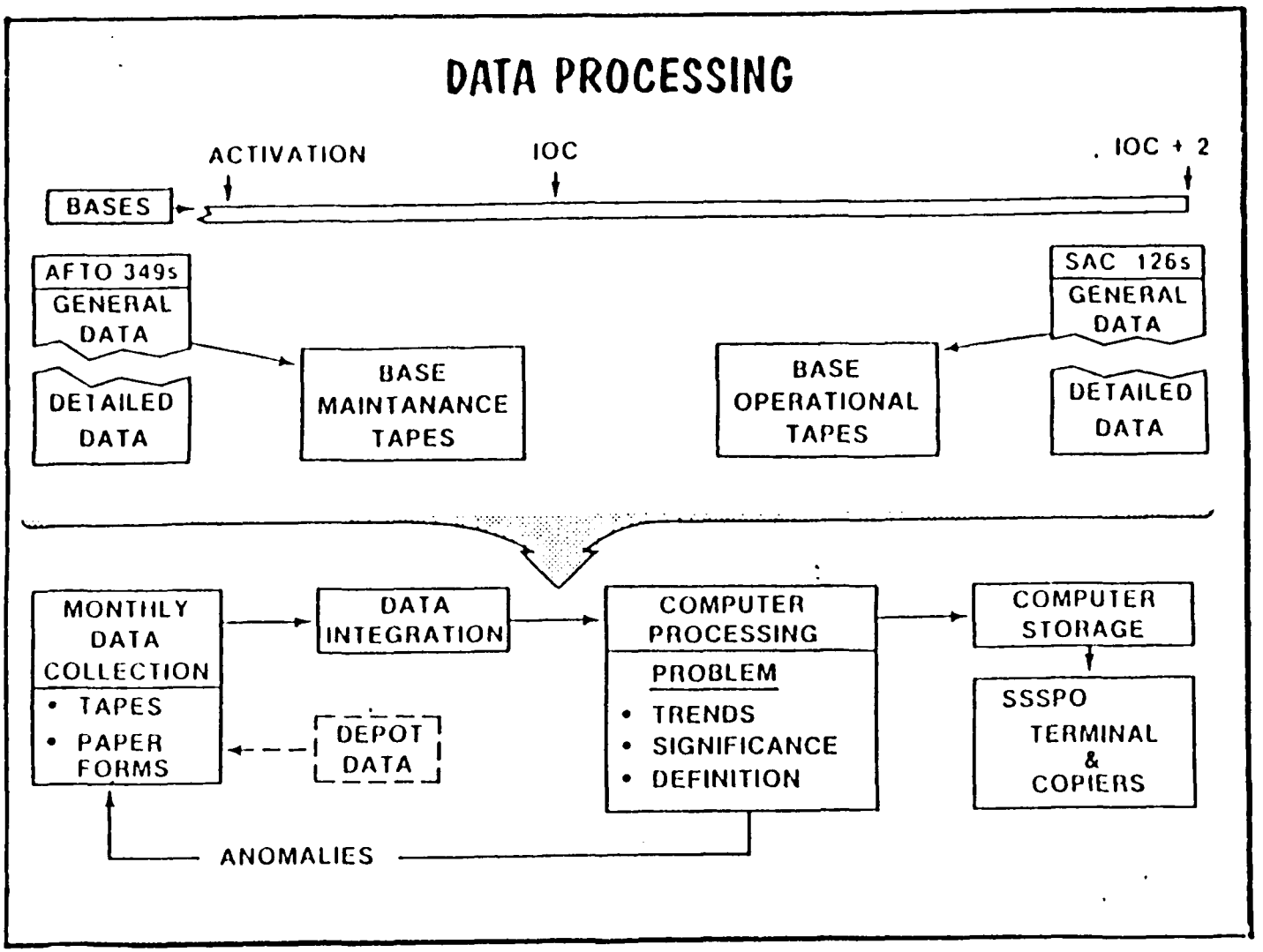


Figure 3. TASC Data Process (6)

TASC system uses the MDC tapes to resolve any anomalies which may occur between the TASC base maintenance tapes and MDC D056 tapes.

7. Quality. The MARCON and TASC systems show the same quality of performance as the MDC system except for the small increase in accuracy for the TASC system resulting from redundant data inputting. The basic reason for the same quality value throughout is that all systems are using the same raw data. Until the collecting and recording of maintenance and operational data improves at the field level, all systems will have the same problem: i.e., output data can be no more accurate than the input data.

Additional Informational Criteria.

8. Cost. Cost data regarding MARCON was unavailable. The development contract for TASC was six million dollars and a twelve-month operational contract was worth $900,000 (6).

9. Type of Reports. Both the MARCON and TASC systems can provide various report types, i.e., monthly, three-month moving average, cumulative, etc. (See Appendices B and C for examples.) Since each system is real-time, it is up to the user to decide his requirement needs. The TASC system can provide information in either tabular, graphic or narrative form. The flexibility in the TASC system outputs provides useful support spanning three areas: (a) overview

and trend information (Table 2); (b) specific equipment or action information (Table 3); and (c) detailed information (Table 4).

10. Sources of basic data. As discussed earlier, the TASC system is the only one which uses redundant sources: base computer tapes along with MDC basic tapes (Figure 3).

11. Storage capability. The MARCON system can retain all data on the F-16 system back to its operational beginning in 1979. The TASC system has on-line data going back to January 1981. However, the MARCON system includes the majority of the systems on the F-16, i.e., the majority of Work Unit Codes (WUC) in the data base (2800 WUC) (3), whereas the TASC system for the Strategic Systems SPO only has data on two areas: Air Launch Cruise Missile and Offensive Avionics System. Other aircraft equipment/systems data has not been inputted in the TASC system.

12. Tracking capability. MARCON and TASC systems both have the capability to monitor and track maintenance data by base, type of aircraft, Work Unit Codes, and to some degree, line replaceable units/shop replaceable units. However, the TASC can track individual aircraft tail numbers more easily than MARCON.

13. Information and users' needs. MARCON system has been beneficial to all the offices in the F-16 SPO and especially to the R&M engineers. In the early part of 1983,

Table 2

FDTS OVERVIEW AND TREND OUTPUT PRODUCTS

PRODUCT TITLE	BRIEF DESCRIPTION OF PRODUCT	SELECTION OPTIONS
WUC/Failures Ranking Report	Lists the most significant work unit codes in terms of number of completed corrective maintenance actions.	Type Malfunction Base From/To Dates Cutoff Number
WUC/Man-Hours Ranking Report	Lists the most significant work unit codes in terms of man-hours expended in maintenance actions.	Type Malfunction Base From/To Dates Cutoff Number
MTBM Event Trend	Compares MTBM event data for a selected WUC against a theoretical curve for that system component or demonstrates actual MTBM trend.	Plot Scale Type Malfunction Base WUC
Capability Percentage Trend	Demonstrates trends in operational capability percentage for selected avionics systems.	Base End Item SAC Form 126 Version Block Number

Table 3

FDTS EQUIPMENT- OR ACTION-SPECIFIC OUTPUT PRODUCTS

PRODUCT TITLE	BRIEF DESCRIPTION OF PRODUCT	SELECTION OPTIONS
WUC Summary Report	Provides summary total of completed corrective maintenance actions.	Base From/To Dates WUC
WUC JCN Index Report	Provides a list of Job Control Numbers (JCN) for completed corrective maintenance actions.	Type Malfunction Base From/To Dates WUC
WUC/How Malfunctioned Report	Lists the most significant how malfunction codes.	Type Malfunction Base From/To Dates Cutoff Number WUC

Table 4

FDTS DETAILED INFORMATION OUTPUT PRODUCTS

PRODUCT TITLE	BRIEF DESCRIPTION OF PRODUCT	SELECTION OPTIONS
Work Unit Code (WUC) Detail Query	Displays descriptions of the various types of maintenance actions performed and estimates of the man-hours expended on each one.	Type Malfunction Base From/To Dates WUC
Job Control Number (JCN) Detail Query	Displays field operations data and maintenance action information from multiple sources.	Base JCN and Year

the program office thought they had an R&M problem with the F-16s at MacDill AFB and Hill AFB. The MARCON data system reports enabled the SPO to reduce the time in determining the actual problem. It was found that the problem was not with any system R&M but rather how maintenance actions were reported. The TASC reports are used to indicate when problems in R&M start to occur. Based on these reports, the SPO can use the information to prioritize problems. Before the TASC system, problems were solved on a "first-come, first served" basis which often led to poor utilization of funds.

14. Benefits. In both systems, the greatest benefit has been in the area of timeliness. The systems save many manhours in collecting, analyzing, and preparing data to solve problems which may arise in the R&M area. Personnel can now spend more time analyzing and evaluating information rather than in collecting the data.

15. Use of the data base. As discussed earlier, the MARCON system covers the majority of equipment on the F-16 system, whereas the TASC system has been very specific in that it only has two subsystems in its data base: the Air Launch Cruise Missile and the Offensive Avionics System.

Numerical Analysis

Based upon the above analysis of each system regarding the 15 criteria areas, a subjective rating was assigned to each system. From the ratings and point values the total

amount of points was determined for each data base system.

For the cost criteria (Number 8), both systems were assigned a rating of zero since cost figures for MARCON and MDC systems were unavailable. The problem with obtaining the cost figures for the MDC system is breaking out the costs specifically incurred by the F-16 and Offensive Avionics/Air Launch Cruise Missile Systems.

The results of the subjective numerical analysis are shown in the matrix below. Even though both systems accumulated 36 points this does not necessarily mean both systems are totally equal. A basic difference will be discussed in the next chapter.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This study was accomplished by addressing two research questions:

1. What are the relative improved performance characteristics of the two new Reliability and Maintainability data bases (MARCON and TASC systems) used by Aeronautical Systems Division (F-16 and Strategic Systems SPOs)?

2. What are the common characteristics of the two new systems?

Research Questions. In order to answer both these questions, it was appropriate to set up common informational criteria, against which both systems were evaluated. The criteria were comprised of a general category, obtained from a previous research thesis which dealt with R&M informational systems, and a specific set of criteria which was closely associated with problem areas experienced by the current Maintenance Data Collection System. Once the criteria were established, a numerical evaluation of the data systems was conducted.

As a result of the evaluation and answering the research

questions, the objectives of this research could be assessed. These objectives were:

1. Main Objective: Do the new systems provide improved R&M information over the present MDC reports?

2. Secondary Objective: Is the R&M information of each system compatible?

Conclusions

Objective 1. Based on the analysis of the data base systems, it can be concluded that both the MARCON and TASC data base systems do provide improved R&M information. The key area of improvement was in timeliness. Each of the systems could assess their data bases in a real-time matter and provide numerous types of formatted documents. By reducing the time requirements, manpower and funds could be saved. But the greatest benefit was that now managers would have access to timely information to aid them in their decision-making processes. Therefore, overall system reliability and maintainability should improve, resulting in weapon systems which meet the supportability and readiness requirements.

Objective 2. The second objective dealt with the compatibility of the two R&M data bases. This study showed no evidence in which the two systems could share basic data from system to system. However, based on the types and formats of each systems output, it would appear that a manual

analysis and comparison could easily be accomplished

Final Conclusion. As shown in objective one above both systems do provide improved R&M information compared to the MDC data system. Also based on the numerical analysis matrix, both systems equaled 36 points. The conclusion drawn from these findings could be that both systems are totally equal and one is not better than the other. However, that is not the fact. Each system has superiority in the particular area for which it was developed. MARCON is a general system and provides maintenance data on the whole F-16 system. Whereas the TASC system was used specifically for two components of an overall weapon system. For overall weapon system R&M, MARCON is superior where TASC is superior in regards to the total R&M picture for a particular component.

The basic finding of this research is that both data base systems do provide their users with timely R&M data. With this data the users have available to them information which allows for effective decision making.

Recommendations

This research effort surfaced some issues related to the subject that need further research. This study concluded that the two new data systems do provide improved R&M data. However, it did not consider the cost effectiveness of the improved capability. An area of further research would be

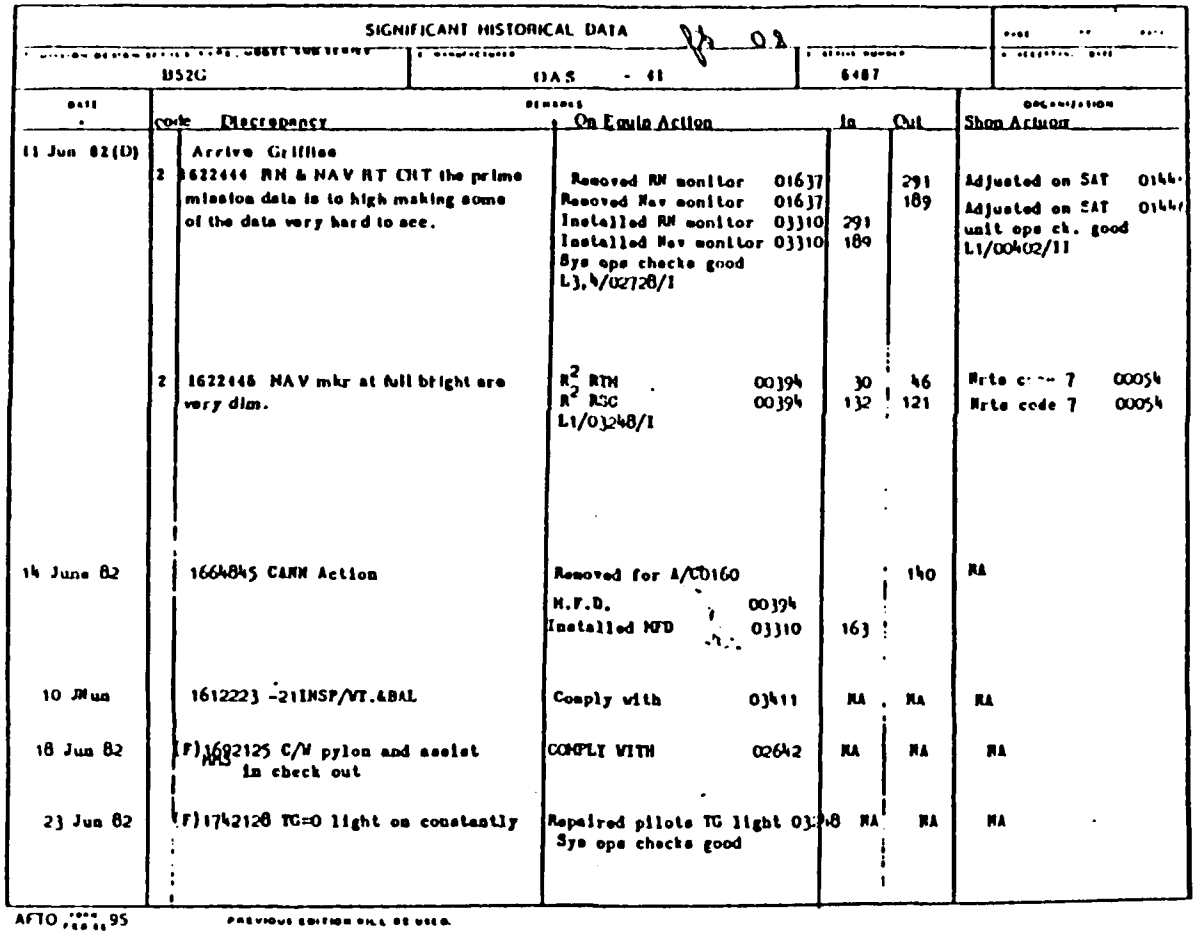
to perform a cost analysis study to determine the financial implications of the additional data systems.

In gathering the data for this study, it was learned that AFLC will be supplementing their present MDC system with a new data system called Maintenance and Operational Data Access System (MODAS). It will be very similar to the F-16 SPO system since MARCON will be the contractor. It is projected to be operational in the early part of 1984. After this system becomes fully functional, it might provide possible areas in which further R&M information research could be performed.

And finally, an area where research is required is in the collection and reporting of maintenance and operational events. No matter how much one improves the computer systems which store, process and analyze data, if erroneous data is put into the computer originally, the final output can only be comparable. So it is imperative that the data collected and reported is error free. While researching this thesis, the fact of input errors always came up in the discussions. With the current trend to improve the output side of the maintenance and operations data base systems, maybe some organization will also attempt to improve the input side. Only then will the Logistic System be able to properly monitor and evaluate weapon system reliability and maintainability.

APPENDIX A

MAINTENANCE DATA COLLECTION REPORTS



SIGNIFICANT HISTORICAL DATA

B52G | OAS - 41 | 6487

Date	Code	Discrepancy	On Equip Action		In	Out	Show Action
11 Jun 82(D)		Arrive Griffiss					
	2	1622444 RN & NAV RT CKT the prime mission data is to high making some of the data very hard to see.	Removed RN monitor Removed Nav monitor Installed RN monitor Installed Nav monitor Sys ops checks good L1,4/02728/1	01637 01637 03310 03310	291 189	291 189	Adjusted on SAT 0144 Adjusted on SAT 0144/ unit ops ck. good L1/00402/11
	2	1622446 NAV mkr at full bright are very dim.	R^2 RTN R^2 RSC L1/03248/1	00394 00394	30 132	46 121	Wrte c[illegible] 7 00054 Wrte code 7 00054
14 June 82		1664845 CANN Action	Removed for A/CD160 M.F.D. Installed MFD	00394 03310	163	140	NA
10 JNun		1612223 -21INSP/WT.&BAL	Comply with	03411	NA	NA	NA
18 Jun 82		F)1682125 C/M pylon and aeslet in check out	COMPLY WITH	02642	NA	NA	NA
23 Jun 82		F)1742128 TG=0 light on constantly	Repaired pilots TG light 03[illegible]8 Sys ops checks good		NA	NA	NA

AFTO [illegible] 95 PREVIOUS EDITION ONLY BE USED.

Form AFTO 95 used to record Significant Historical Data

MISSION RECORD - AVIONICS

0	4	1	6	5	2	G	6	4	8	7	0	5	H	0	1	1

PART II — AVIONICS DISCREPANCIES

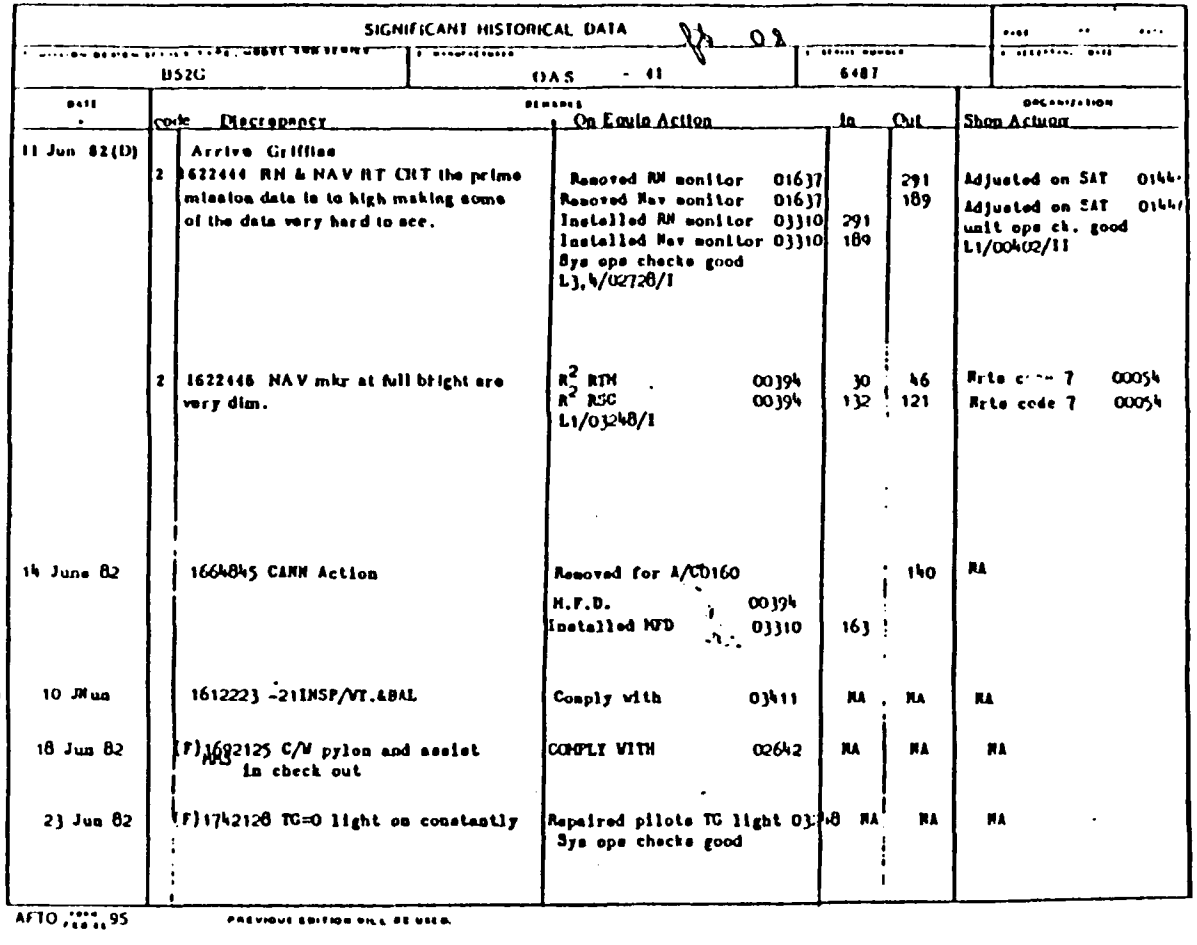
42/5 1802439 (PSU) TA trace unuseable all ranges.
43/2 2182410 (DFCS) TO+6:00 Dot cursor indicated 5° low at end of the flight turret was stowed 5° left.
43/2 2182406 (DFCS) TO+14 min during normal prediction CK with turret full down limit light blinked once then went off. (in all modes.)
43/2 2182407 (DFCS) TO+20 min. During azimuth aided rate + gyro servos as circle cursor would not drive through LT scope limits without a large input.
43/2 2182408 (DFCS) TO+27 min. In Emer on mode ## circle cursor appeared 5° RT of scope. center.
43/2 2182409 (DFCS) TO+2:25 Sys would not track chaff or real targets in RT/RR system would track real targets in MT/RR.
53/2 2152425 (PVU) LT outbd gradually decreases.

EQUIPMENT MALFUNCTIONS

Card No.		Rep.
5	1	1
5	2	1
5	3	1
5	4	1
5	5	1
5	6	1
5	7	1

SAC FORM 126a REVISED

Form SAC 126 used to record Mission Record - Avionics



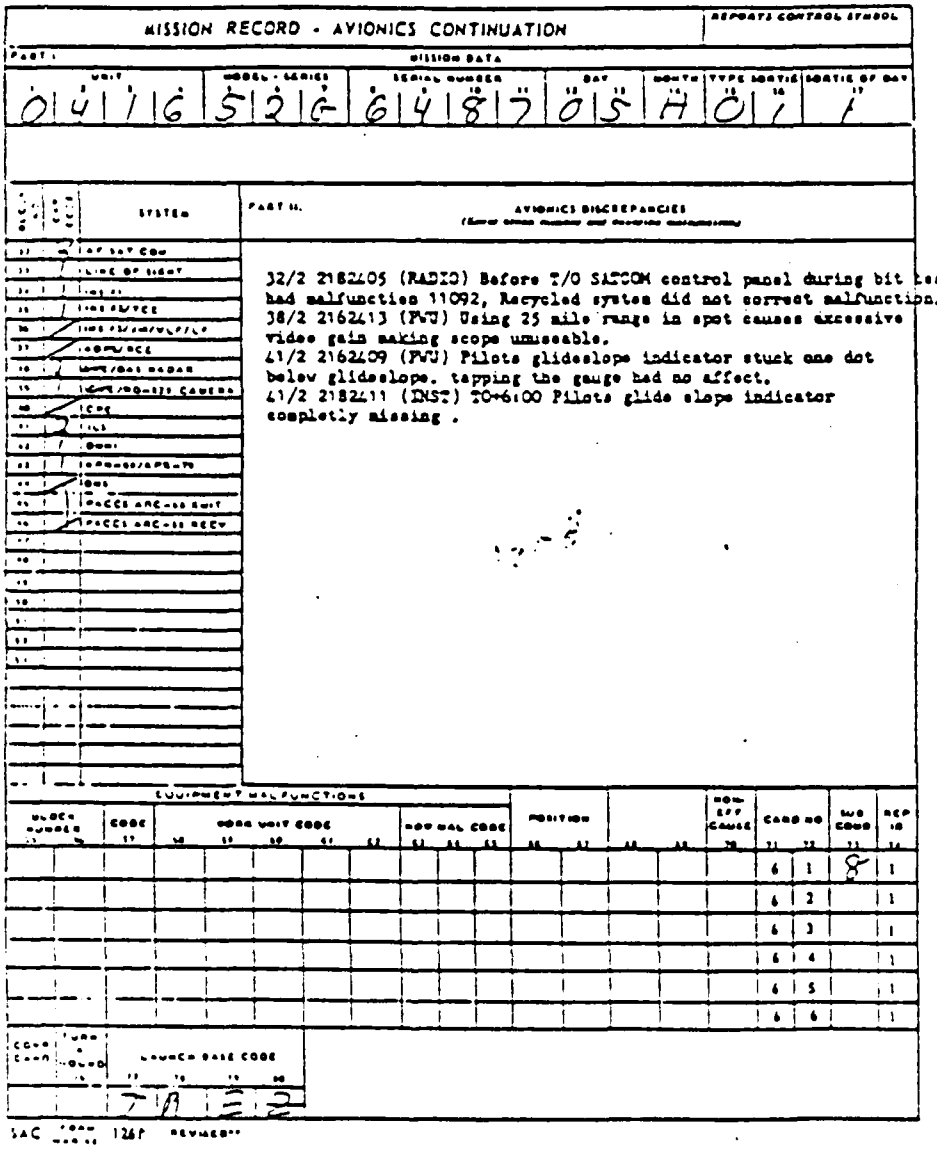
SIGNIFICANT HISTORICAL DATA

B52G | OAS - 41 | 6487

DATE	CODE	DISCREPANCY	ON EQUIP ACTION		In	Out	SUBSEQUENT ACTION
11 Jun 82(D)		Arrive Griffiss					
	2	1622444 RN & NAV RT CRT the prime mission data is to high making some of the data very hard to see.	Removed RN monitor Removed Nav monitor Installed RN monitor Installed Nav monitor Sys ope checks good L1,4/02728/I	01637 01637 03310 03310	291 189	291 189	Adjusted on SAT 0144 Adjusted on SAT 0144/ unit ops ck. good L1/00402/II
	2	1622446 NAV mkr at full bright are very dim.	R^2 RTM R^2 RSC L1/03248/I	00394 00394	30 132	46 121	Rrte code 7 00054 Rrte code 7 00054
14 June 82		1664845 CANN Action	Removed for A/CD160 M.F.D. Installed MFD	00394 03310	163	140	NA
10 JNun		1612223 -21INSP/VT.&BAL	Comply with	03411	NA	NA	NA
18 Jun 82		(F)1682125 C/M pylon and assist in check out	COMPLY WITH	02642	NA	NA	NA
23 Jun 82		(F)1742128 TG=0 light on constantly	Repaired pilots TG light 03 Sys ops checks good	48	NA	NA	NA

AFTO FORM 95 PREVIOUS EDITION WILL BE USED.

Form AFTO 95 used to record Significant Historical Data



MISSION RECORD - AVIONICS CONTINUATION

REPORTS CONTROL SYMBOL

PART I — MISSION DATA

UNIT	MODEL - SERIES	SERIAL NUMBER	DAY	MONTH	TYPE MSN	MSN OF DAY
01716	52G	64183	05	H	01	1

PART II. AVIONICS DISCREPANCIES

32/2 2182405 (RADIO) Before T/O SATCOM control panel during bit test had malfunction 11092, Recycled system did not correct malfunction.
38/2 2162413 (FWJ) Using 25 mile range in spot causes excessive video gain making scope unuseable.
41/2 2162409 (FWJ) Pilots glideslope indicator stuck one dot below glideslope. tapping the gauge had no affect.
41/2 2182411 (INST) 20+6100 Pilots glide slope indicator completly missing .

EQUIPMENT MALFUNCTIONS

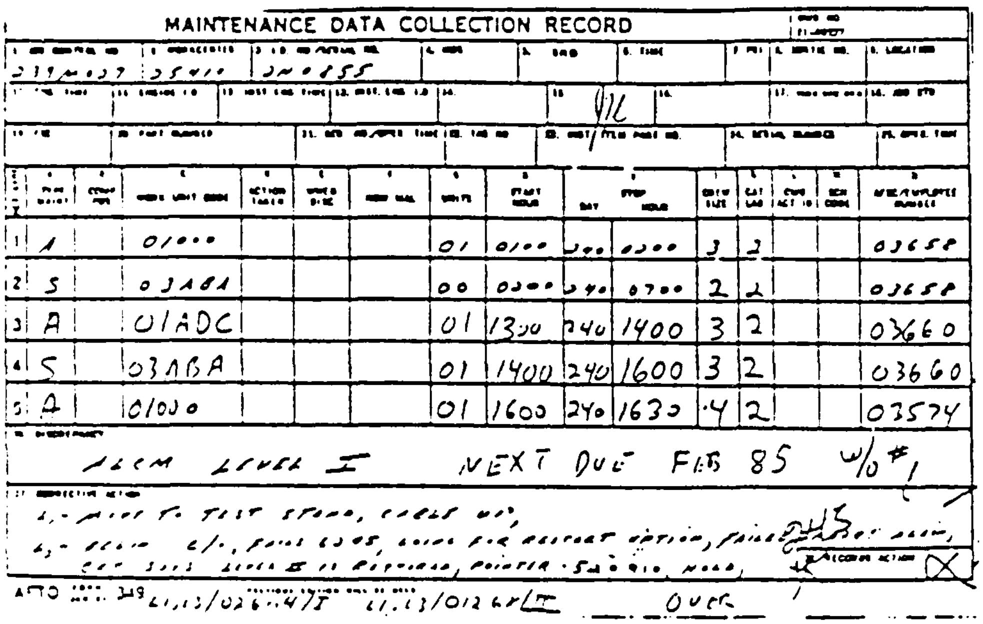
BLOCK NUMBER	CODE	WORK UNIT CODE	NOT MC CODE	POSITION				NON-OPT CAUSE	CORR NO	MAL CODE	REP ID
									61	8	1
									62		1
									63		1
									64		1
									65		1
									66		1

CODE | CODE — LAUNCH BASE CODE: 7A=2

SAC 126F REVISED

Form SAC 126F used to record Mission Record - Avionics

Front



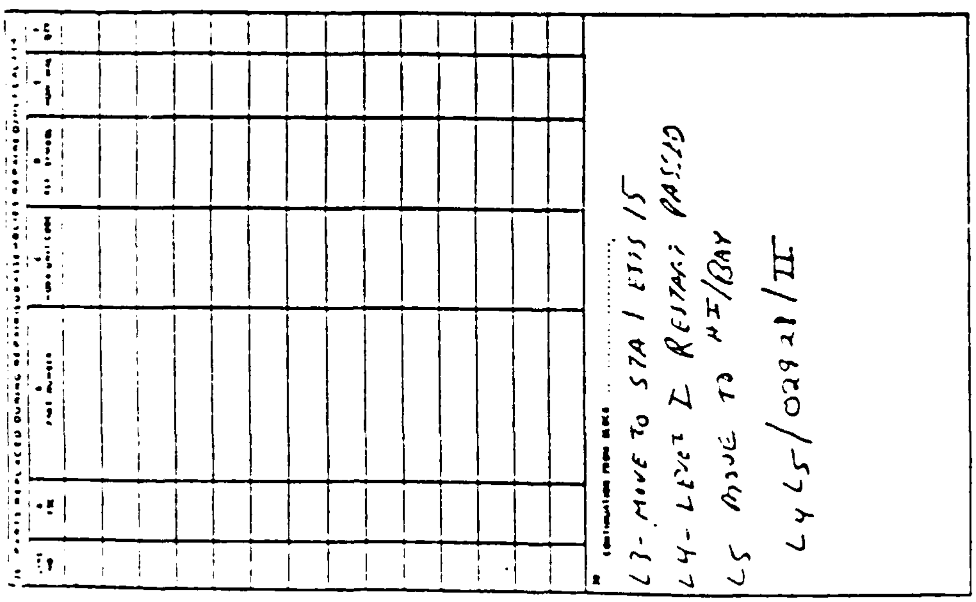
MAINTENANCE DATA COLLECTION RECORD

1	A		01000				01	0100	240	0200	3	2			03658
2	S		03ABA				00	0200	240	0700	2	2			03658
3	A		01ADC				01	1300	240	1400	3	2			03660
4	S		03ABA				01	1400	240	1600	3	2			03660
5	A		01000				01	1600	240	1630	4	2			03574

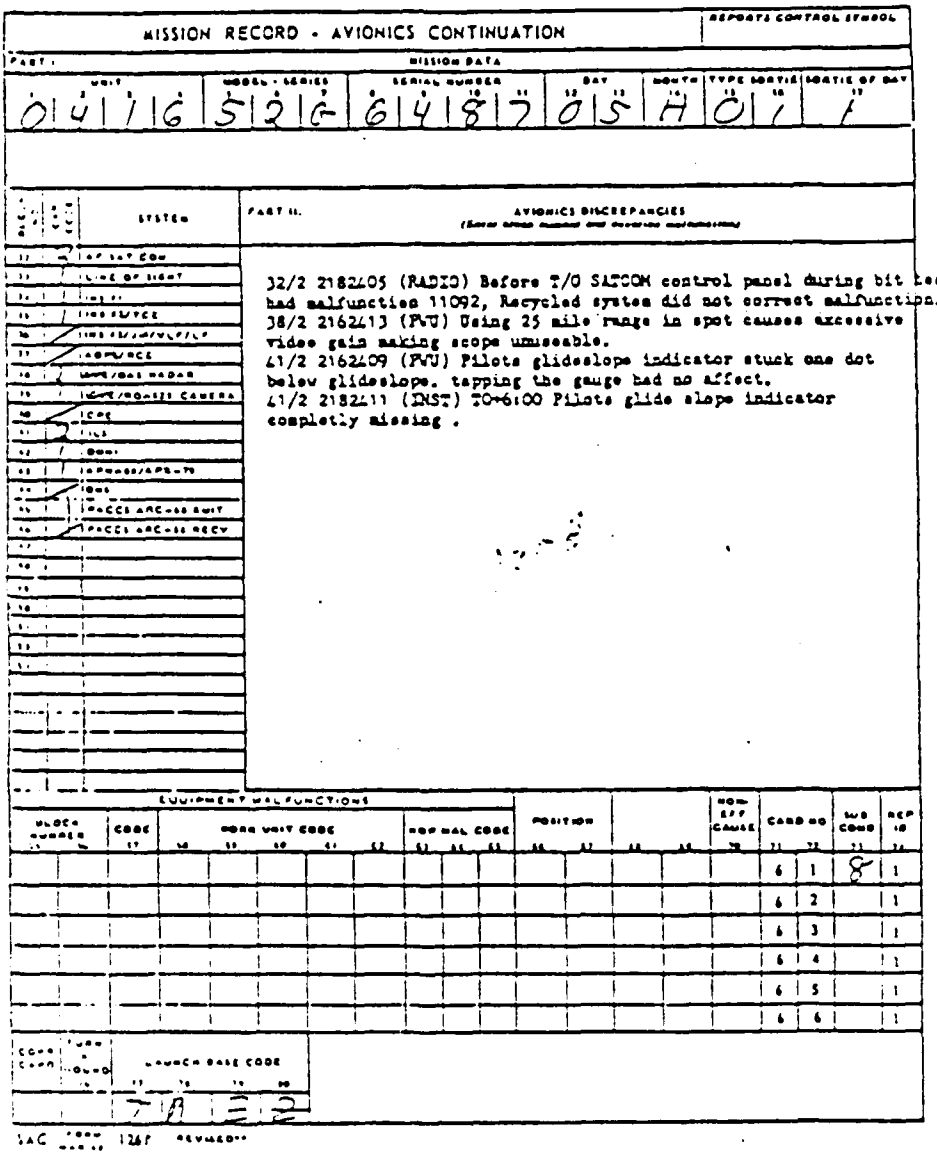
ALCM LEVEL I NEXT DUE FEB 85 W/O #1

OVER

Reverse



Form AFTO 349 used to record Maintenance Data



MISSION RECORD - AVIONICS CONTINUATION

REPORTS CONTROL SYMBOL

PART I. MISSION DATA

UNIT	MODEL - SERIES	SERIAL NUMBER	DAY	MONTH	TYPE SORTIE	SORTIE OF DAY
01716	52G	64837	05	H	O	1

PART II. AVIONICS DISCREPANCIES

32/2 2182405 (RADIO) Before T/O SATCOM control panel during bit tes had malfunction 11092, Recycled system did not correct malfunction.
38/2 2162413 (FWD) Using 25 mile range in spot causes excessive video gain making scope unuseable.
41/2 2162409 (FWD) Pilots glideslope indicator stuck one dot below glideslope, tapping the gauge had no affect.
41/2 2182411 (INST) TO-6:00 Pilots glide slope indicator completly missing .

EQUIPMENT MALFUNCTIONS

BLOCK NUMBER	CODE	WORK UNIT CODE	MALFUNCTION CODE	POSITION		MDC EFF CAUSE	CAND NO	SUB CODE	REP ID
							61	8	1
							62		1
							63		1
							64		1
							65		1
							66		1

CODE | TYPE | LAUNCH BASE CODE

7 A E P

SAC 126F REVISED

Form SAC 126F used to record Mission Record - Avionics

APPENDIX B

EXAMPLES OF MARCON COMPUTERIZED MAINTENANCE DATA

RELIABILITY STATUS REPORT PAGE 1 OF 3 PAGES 831207

WUC: 51FA0 COMPUTER, CENTRAL AIR DATA
TYPE 1 FAILURES USAF AFB
EQUIPMENT LEVEL 4 PROJECTED CUM MTBMA AT 500K FLTHRS 0.00

DATE	ACTUAL FLYING HOURS M	B	CUM. FLIGHT HOURS	FAIL	MONTHLY ACTUAL MTBMA	3 MONTH AVERAGE MTBMA	ACTUAL CUM. MTBMA	PROJ. CUM. MTBMA
79/01	43	0	43	0	0.00		0.00	0.00
79/02	95	0	138	1	95.00		138.00	0.00
79/03	45	82	265	0	0.00	265.00	265.00	0.00
79/04	84	125	474	0	0.00	431.00	474.00	0.00
79/05	145	132	751	0	0.00		751.00	0.00
79/06	109	201	1061	0	0.00		1061.00	0.00
79/07	193	194	1448	0	0.00		1448.00	0.00
79/08	184	177	1809	0	0.00		1809.00	0.00
79/09	341	335	2485	0	0.00		2485.00	0.00
79/10	557	451	3493	0	0.00		3493.00	0.00
79/11	598	367	4458	1	965.00	2485.00	2229.00	0.00
79/12	502	377	5337	3	293.00	713.00	1067.40	0.00
80/01	599	475	6411	2	537.00	486.33	915.86	0.00
80/02	768	556	7735	1	1324.00	546.17	966.88	0.00
80/03	997	525	9257	1	1522.00	980.00	1028.56	0.00
80/04	991	759	11007	2	875.00	1149.00	1000.64	0.00
80/05	1207	714	12928	4	480.25	741.86	861.87	0.00
80/06	1332	694	14954	0	0.00	949.50	996.93	0.00
80/07	1609	731	17294	2	1170.00	1047.83	1017.29	0.00
80/08	1572	878	19744	6	408.33	852.00	858.43	0.00
80/09	1496	749	21989	0	0.00	879.38	956.04	0.00
80/10	2241	927	25157	0	0.00	1310.50	1093.78	0.00
80/11	2006	834	27997	4	710.00	2063.25	1036.93	0.00
80/12	1869	802	30668	4	667.75	1084.88	989.29	0.00

APPENDIX B

EXAMPLES OF MARCON COMPUTERIZED MAINTENANCE DATA

RELIABILITY STATUS REPORT PAGE 2 OF 3 PAGES 831207

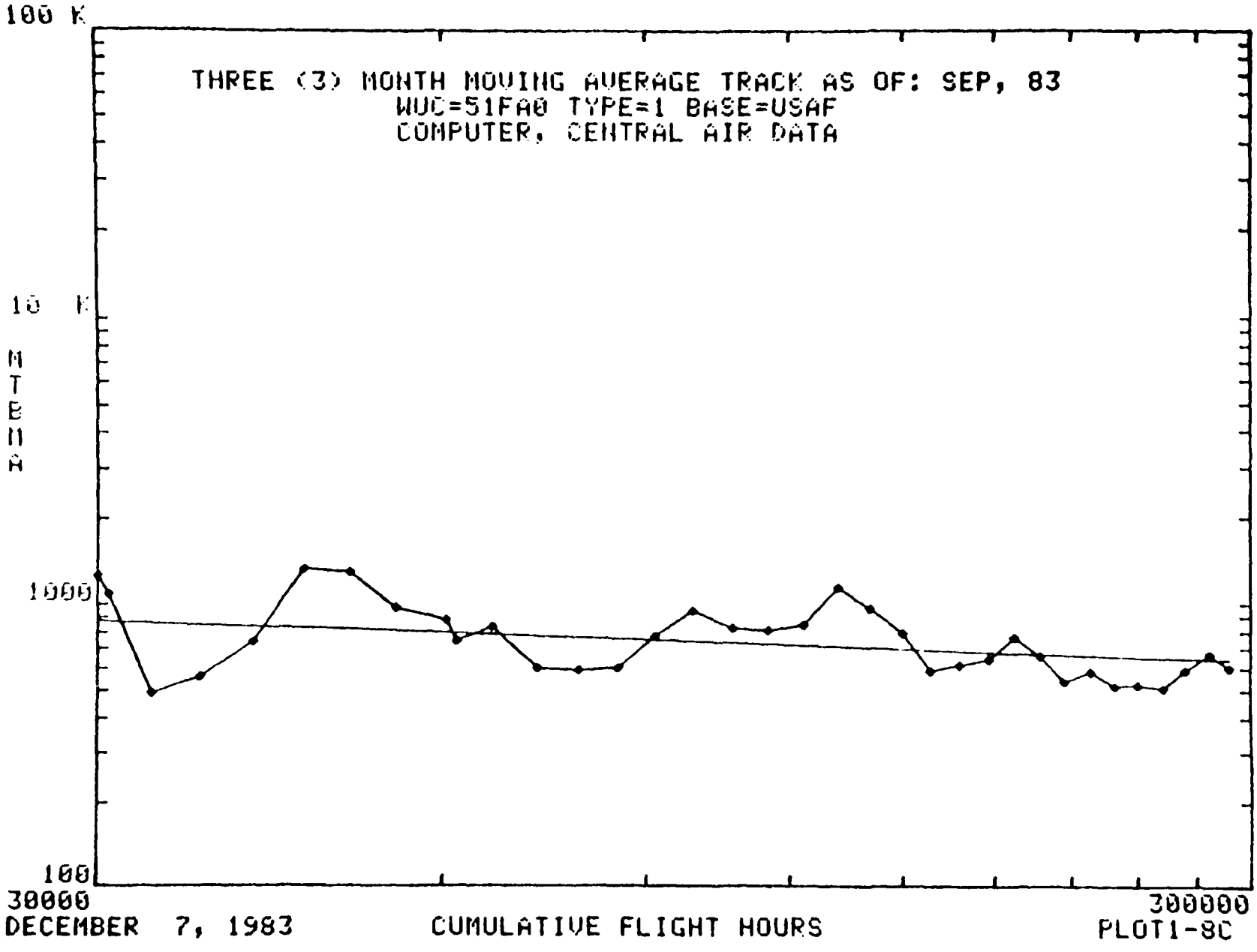
WUC: 51FA0 COMPUTER, CENTRAL AIR DATA
TYPE 1 FAILURES USAF AFB
EQUIPMENT LEVEL 4 PROJECTED CUM MTBMA AT 500K FLTHRS 0.00

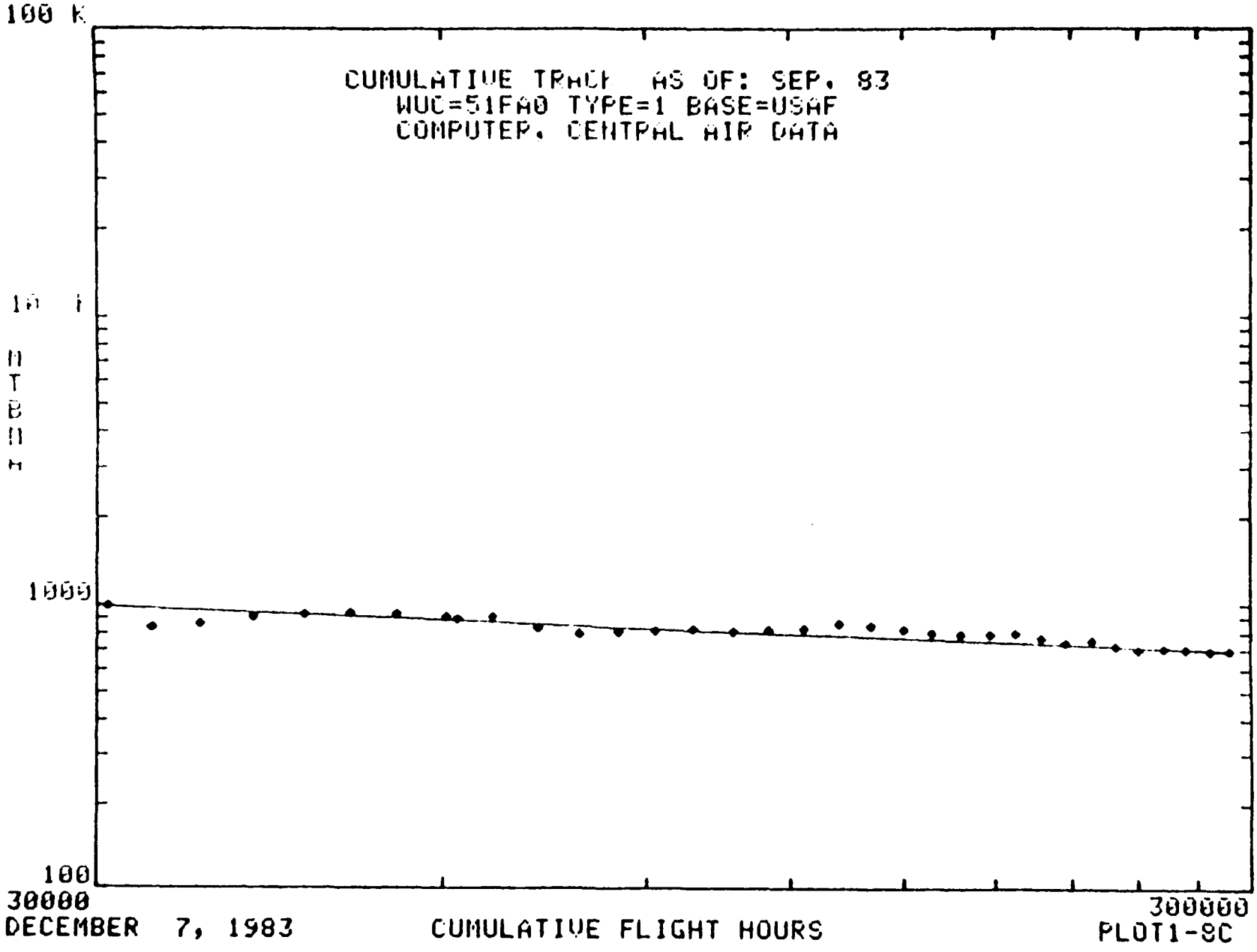
DATE	ACTUAL FLYING HOURS A	B	CUM. FLIGHT HOURS	FAIL	MONTHLY ACTUAL MTBMA	3 MONTH AVERAGE MTBMA	ACTUAL CUM. MTBMA	PROJ. CUM. MTBMA
81/01	2131	730	33529	9	317.89	492.47	838.22	0.00
81/02	2442	956	36927	3	1132.67	558.13	858.77	0.00
81/03	3143	1015	41085	2	2079.00	744.07	913.00	0.00
81/04	3322	1028	45435	4	1087.50	1322.89	927.24	0.00
81/05	3318	1044	49797	4	1090.50	1287.00	939.57	0.00
81/06	3675	1163	54635	6	806.33	967.86	926.02	0.00
81/07	4601	1106	60342	7	815.29	876.88	914.27	0.00
81/08	1025	263	61630	3	429.33	739.56	892.19	0.00
81/09	3393	1236	66259	4	1157.25	830.29	907.66	0.00
81/10	4789	1274	72322	13	466.38	599.00	840.95	0.00
81/11	4999	1385	78706	12	532.00	588.83	803.12	0.00
81/12	4901	1261	84868	5	1027.00	600.29	816.04	0.00
82/01	5165	1496	91529	7	951.57	768.28	824.59	0.00
82/02	5680	1437	98646	8	889.63	949.52	828.96	0.00
82/03	6726	1699	107071	12	702.08	822.33	817.34	0.00
82/04	6257	1522	114850	9	964.33	804.17	820.36	0.00
82/05	6753	1577	123180	8	1041.25	846.00	832.30	0.00
82/06	7124	1921	132225	5	1809.00	1143.36	864.22	0.00
82/07	7022	1560	140807	14	613.00	961.37	843.16	0.00
82/08	7836	1572	150215	15	627.20	795.15	835.36	0.00
82/09	7002	1437	158654	16	527.44	587.31	801.28	0.00
82/10	8087	1688	168429	14	698.21	613.82	794.48	0.00
82/11	8491	1588	178508	14	719.93	643.02	789.96	0.00
82/12	7976	1401	187885	10	937.70	769.24	796.12	0.00

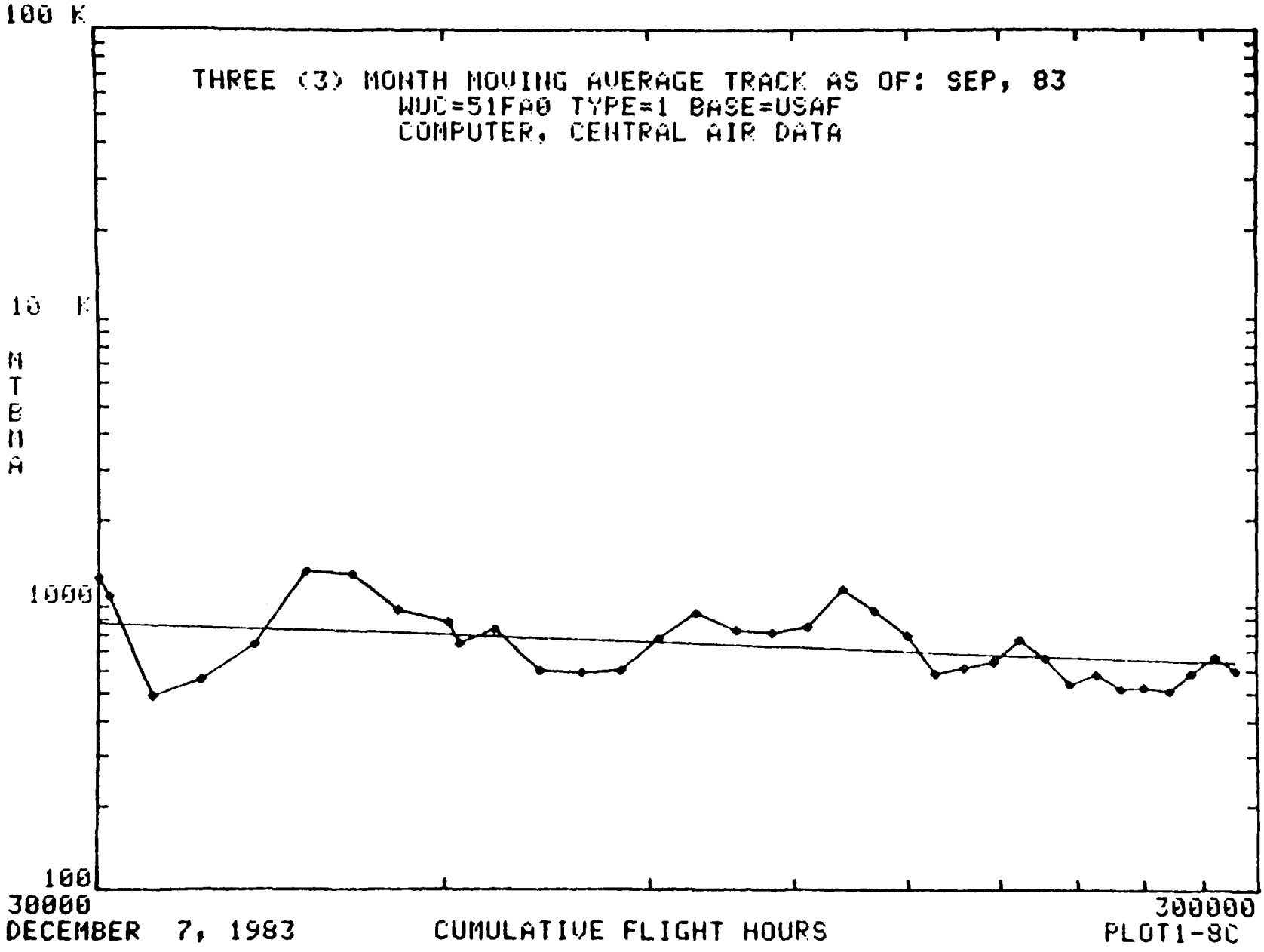
RELIABILITY STATUS REPORT PAGE 3 OF 3 PAGES 831207

WUC: 51FA0 COMPUTER, CENTRAL AIR DATA
TYPE 1 FAILURES USAF AFB
EQUIPMENT LEVEL 4 PROJECTED CUM MTBMA AT 500K FLTHRS 0.00

DATE	ACTUAL FLYING HOURS A	B	CUM. FLIGHT HOURS	FAIL	MONTHLY ACTUAL MTBMA	3 MONTH AVERAGE MTBMA	ACTUAL CUM. MTBMA	PROJ. CUM. MTBMA
83/01	8243	1474	197602	20	485.85	663.02	771.88	0.00
83/02	8592	1306	207500	24	412.42	536.89	741.07	0.00
83/03	9411	1754	218665	9	1240.56	580.75	756.63	0.00
83/04	9134	1546	229345	28	381.43	520.30	723.49	0.00
83/05	9729	1536	240610	26	433.27	525.56	701.49	0.00
83/06	10549	1635	252794	13	937.23	509.39	710.10	0.00
83/07	10165	1500	264459	21	555.48	585.23	701.48	0.00
83/08	11075	1977	277511	21	621.52	670.93	697.26	0.00
83/09	8888	1508	287907	17	611.53	595.14	693.75	0.00
TOTAL	231227	56680		415				


100 K
THREE (3) MONTH MOVING AVERAGE TRACK AS OF: SEP, 83
WUC=51FA0 TYPE=1 BASE=USAF
COMPUTER, CENTRAL AIR DATA
10 K
MTBMA
1000
100
30000
300000
DECEMBER 7, 1983
CUMULATIVE FLIGHT HOURS
PLOT1-8C


100 K
CUMULATIVE TRACK AS OF: SEP. 83
WUC=51FA0 TYPE=1 BASE=USAF
COMPUTER. CENTRAL AIR DATA
1000
100
30000
300000
DECEMBER 7, 1983
CUMULATIVE FLIGHT HOURS
PLOT1-SC


100 K
THREE (3) MONTH MOVING AVERAGE TRACK AS OF: SEP, 83
WUC=51FA0 TYPE=1 BASE=USAF
COMPUTER, CENTRAL AIR DATA
10 K
MTBMA
1000
100
30000
300000
DECEMBER 7, 1983
CUMULATIVE FLIGHT HOURS
PLOT1-8C

APPENDIX C

EXAMPLES OF TASC COMPUTERIZED MAINTENANCE DATA

1 FEB 83 TO 30 APR 83
GRIFFISS MINOT
OAS FUNCTIONAL SYSTEM

FLEET OAS WUC RANKING REPORT FOR TYPE 1 ACTIONS

TOTAL ACTIONS: 628 FROM: 83/02/01 TO: 83/04/30

LIST	WUC	ACTIONS	PERCENT	EQUIPMENT NAME	COMMENTS
1	73CG	103	16.4	**RADAR SET INSTALLATION (CON	RETAINED EQUIP.
2	73KA	50	8.0	**CONTROL UNIT AVIONICS	YY EQUIP.
3	73RB	47	7.5	**RECEIVER-TRANSMITTER-MODULE	YY EQUIP.
4	73LK	~~35~~ 5	5.6	**CONTROL RADAR SET RNMP	DATA ERROR
5	73CF	33	5.3	**RADAR SET INSTALLATION	RETAINED EQUIP.
6	73RA	30	4.8	**ANTENNA, RADAR OAS MODIFIED	RETAINED EQUIP. (1)
7	73LE	20	3.2	**RECORDER VIDEO	YY EQUIP.
8	73PA	20	3.2	**INERTIAL MEASUREMENT UNIT INU	GFAE
9	73CP	18	2.9	**ANGLE OF ATTACK INSTALLATION	RETAINED EQUIP.
10	73LB	18	2.9	**IND, MULTI DISP MFD	YY EQUIP.

NOTES:

(1) ONLY YY CHANGE TO RADAR ANTENNA IS FERRITE SWITCH WHICH IS NOT FAILING

APPENDIX C

EXAMPLES OF TASC COMPUTERIZED MAINTENANCE DATA

1 FEB 83 TO 30 APR 83

GRIFFISS MINOT

OAS - YY CONTRACTUAL SYSTEM

RUN: 83/06/13 19:20 EST DATA AS OF: 83/04/30 PAGE 1

FLEET OAS MTBM VARIANCE RANKING REPORT
FOR TYPE 1 ACTIONS

			MTBM	MTBM		
			---	---	---	---
1	7	[illegible]	8612.1	251.5	--MT BASE ELECT DO.....	YY EQUIP.
2	7	[illegible]	6629.0	2515.3	--INDICATOR HEIGHT.....	YY EQUIP.
3	7	[illegible]	3122.7	83.6	--ANTENNA, RADAR OAS (4)...	RETAINED EQUIP. (4)
4	7	[illegible]	2346.5	1257.6	--CONTROL INDICATOR RAP...	YY EQUIP.
5	7	[illegible]	2052.3	419.2	(1)--CONVERTER, SIGNAL DAT...	YY EQUIP.
6	7	[illegible]	1432.7	251.5	--CONTROL COMPUTER CS:P...	YY EQUIP.
7	7	[illegible]	1320.6	251.5	(2)--CONVERTER, SIGNAL DA...	YY EQUIP.
8	7	[illegible]	2326.9	1437.3	--TRANSPORT MAG TAPE.....	YY EQUIP.
9	7	[illegible]	1017.4	279.5	--IND, MULTI DISP MFD.....	YY EQUIP.
10	7	[illegible]	[illegible]	251.5	(3)--CONVERTER SIGNAL DA...	YY EQUIP.

NOTES

(1) CONTROL DISPLAY INTERFACE UNIT.

(2) ARMAMENT INTERFACE UNIT.

(3) RADAR INTERFACE UNIT.

(4) ONLY YY PART IN ANTENNA IS FERRITE SWITCH

1 FEB 83 TO 30 MAR 83
GRIFFISS MINOT
OAS FUNCTIONAL SYSTEM

RUN: 83/06/13 21:54 EST DATA AS OF : 83/04/30

FLEET OAS WUC MAINTENANCE MAN-HOURS RANKING FOR ALL ACTIONS

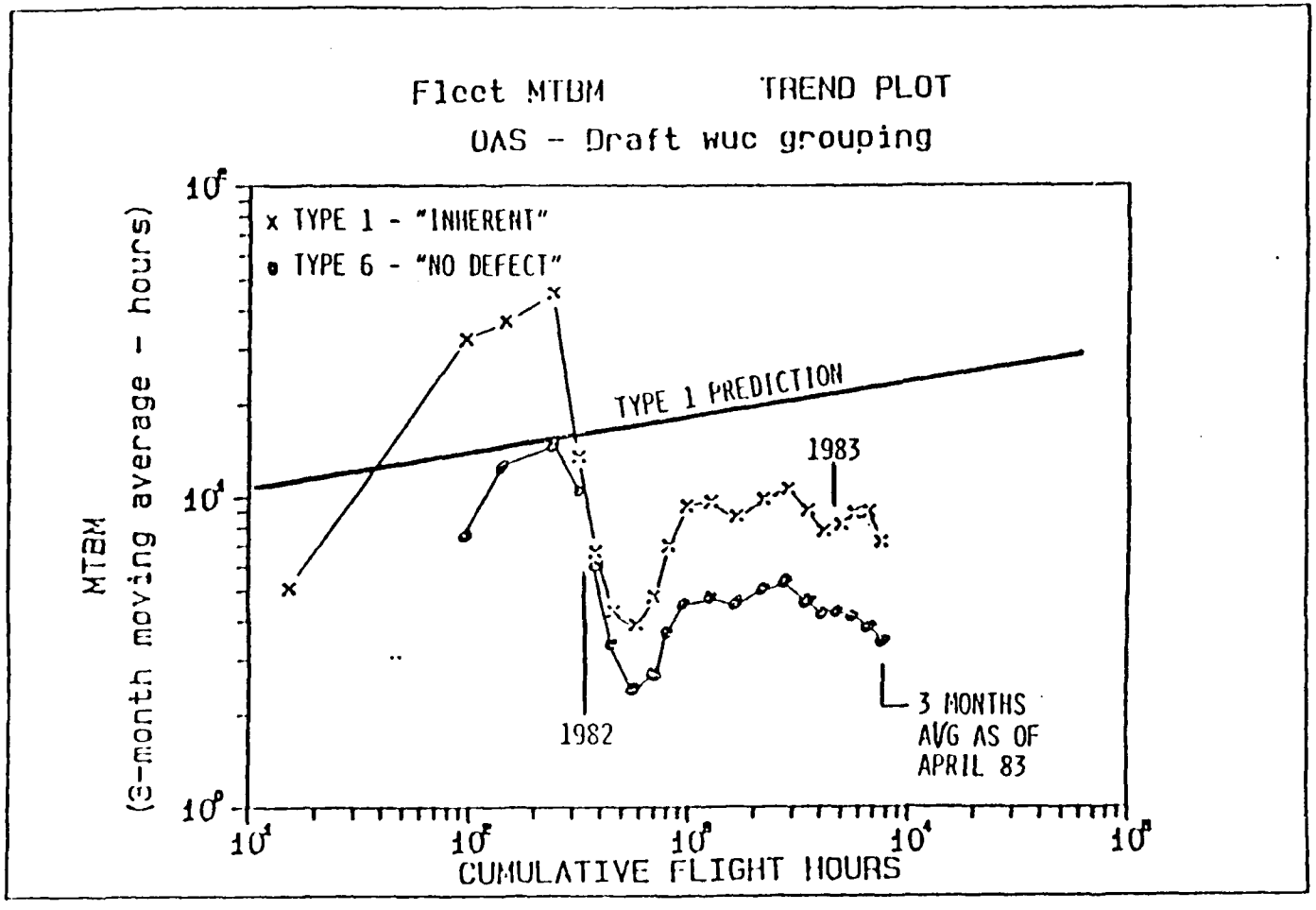
TOTAL MAN-HOURS: 13230.2 FROM: 83/02/01 TO: 83/04/30

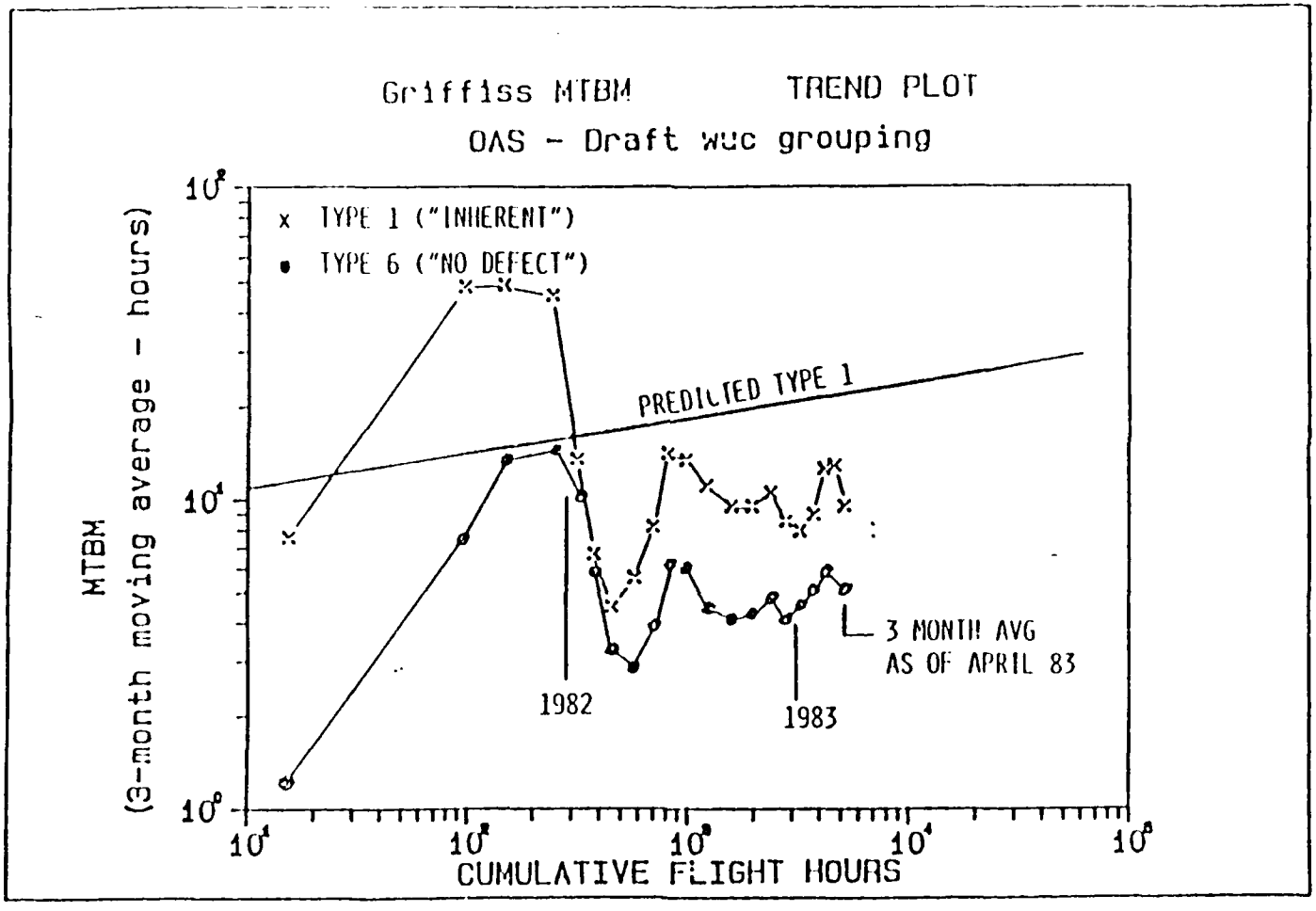
LIST	WUC	MAN HOURS	PERCENT	EQUIPMENT NAME	COMMENTS
1	73CG	1825.0	13.8	**RADAR SET INSTALLATION (CONT.....	RETAINED EQUIP.
2	73RB	1470.8	11.1	**RECEIVER-TRANSMITTER-MODULAT.....	YY EQUIP.
3	73R0	1170.8	8.8	**RADAR SET GROUP.....	NOT AN EQUIP.
4	73KA	1052.2	8.0	**CONTROL UNIT AVIONICS.....	YY EQUIP.
5	73PC	939.0	7.1	**INS ROTOR SUPPORT BATTERY AS.....	GFAE
6	73PA	506.1	3.8	**INERTIAL MEASURMENT UNIT IMU.....	GFAE
7	73RA	451.7	3.4	**ANTENNA, RADAR OAS MODIFIED	RETAINED EQUIP. (1)
8	73HA	305.3	2.3	**DOPPLER VELOCITY SENSOR.....	GFAE
9	[illegible]	10.9	2.3	**RADAR SET INSTALLATION	RETAINED EQUIP.
10	[illegible]	[illegible]	[illegible]	[illegible]	GFAE

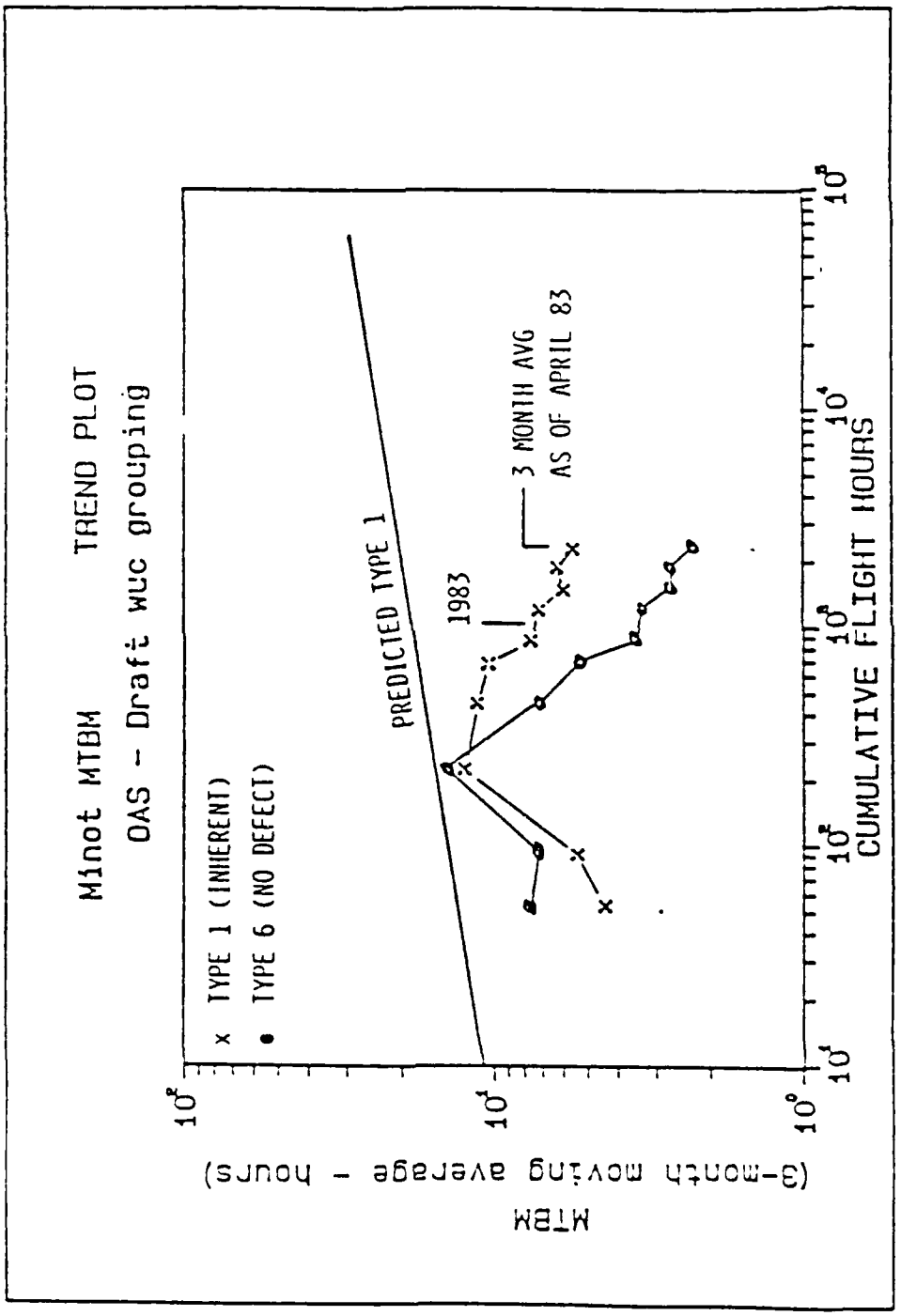
NOTE

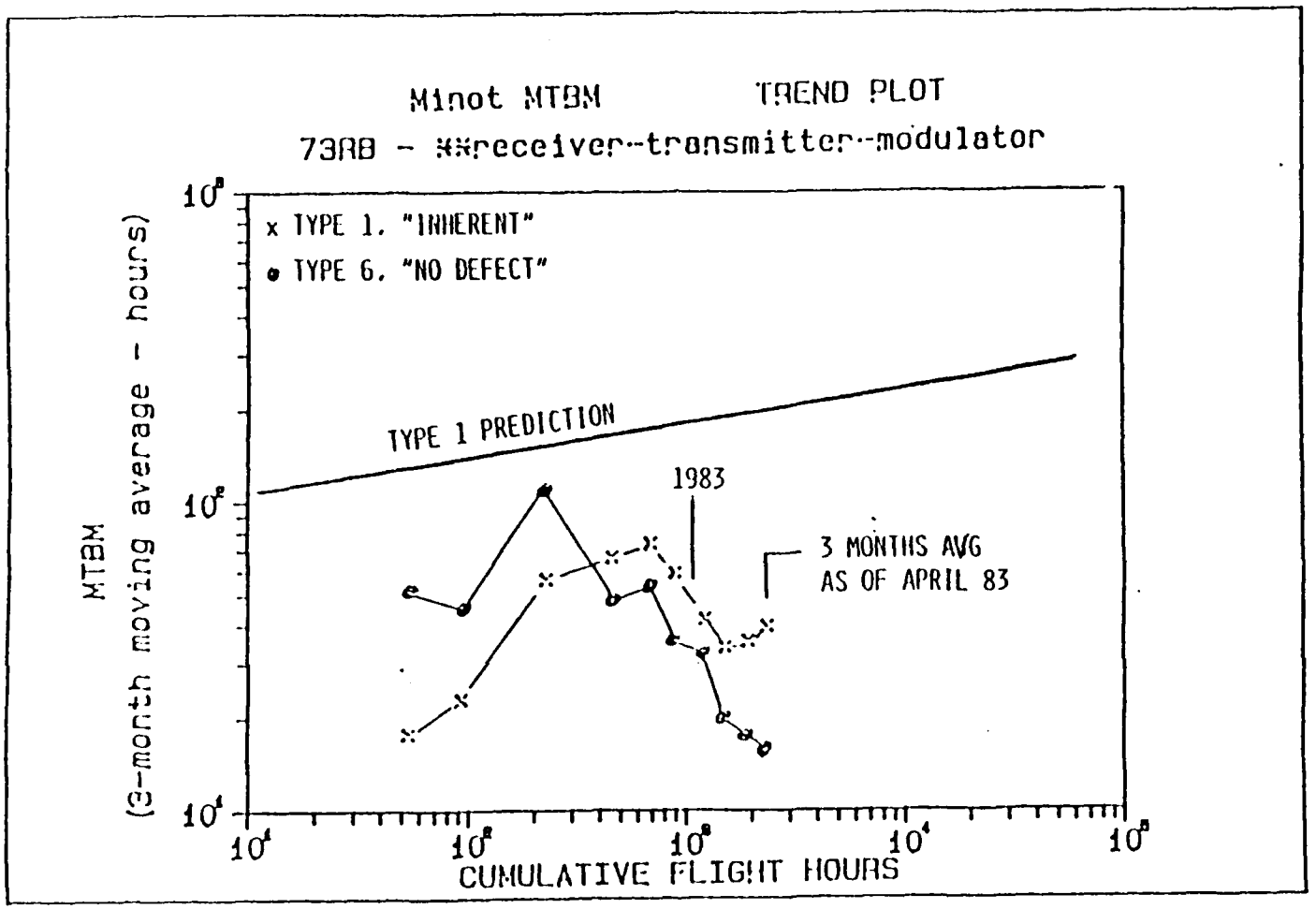
(1) ONLY YY PART IN ANTENNA IS FERRITE SWITCH.

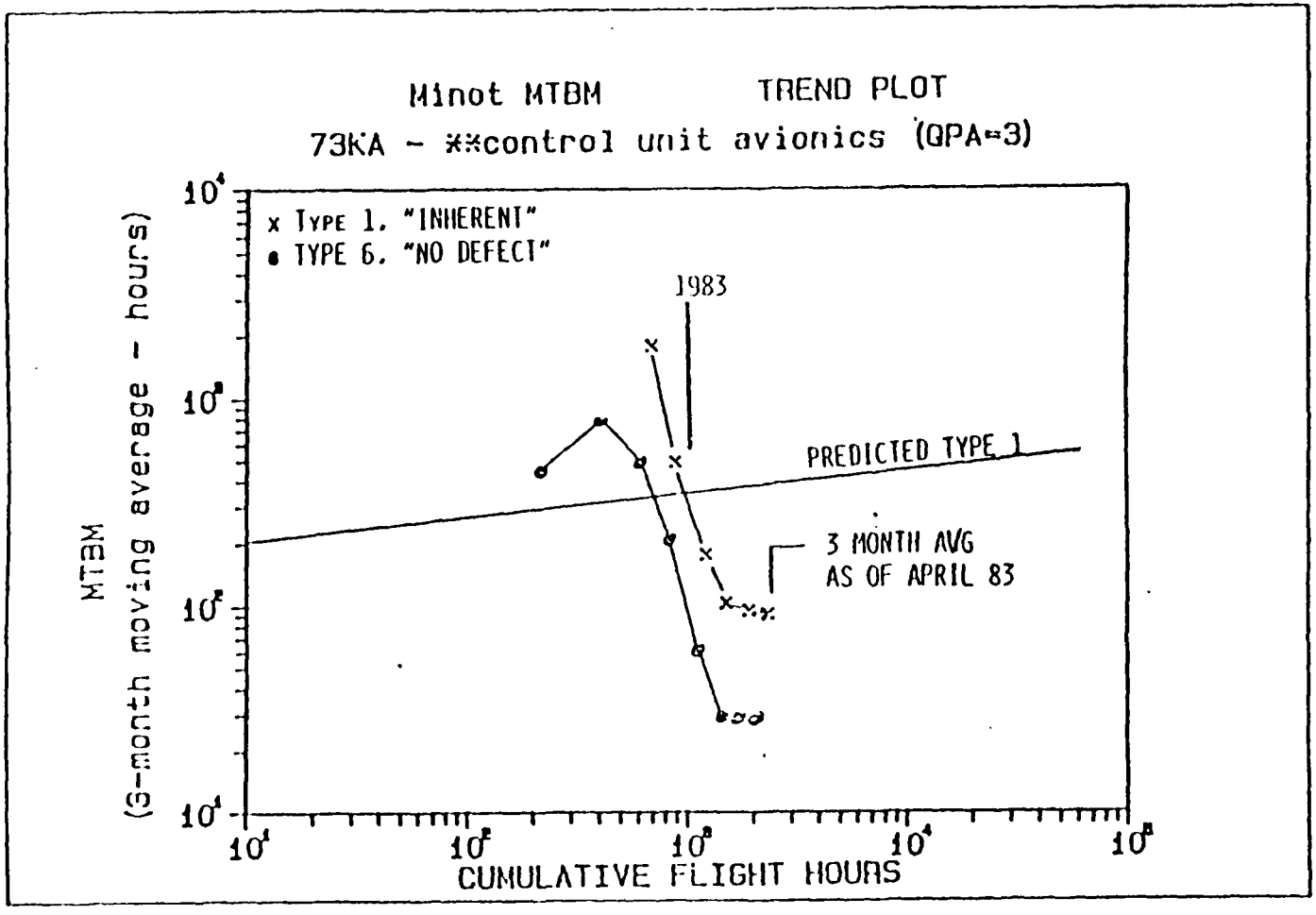
BASES: GRIFFISS MINOT




Griffiss MTBM TREND PLOT
OAS - Draft wuc grouping
x TYPE 1 ("INHERENT")
• TYPE 6 ("NO DEFECT")
PREDICTED TYPE 1
3 MONTH AVG
AS OF APRIL 83
1982
1983
MTBM
(3-month moving average - hours)
CUMULATIVE FLIGHT HOURS


Minot MTBM
TREND PLOT
OAS - Draft WUC grouping
x TYPE 1 (INHERENT)
• TYPE 6 (NO DEFECT)
PREDICTED TYPE 1
1983
3 MONTH AVG
AS OF APRIL 83
MTBM
(3-month moving average - hours)
CUMULATIVE FLIGHT HOURS


Minot MTBM TREND PLOT
7388 - **receiver-transmitter-modulator
x TYPE 1. "INHERENT"
• TYPE 6. "NO DEFECT"
TYPE 1 PREDICTION
1983
3 MONTHS AVG
AS OF APRIL 83
MTBM
(3-month moving average - hours)
CUMULATIVE FLIGHT HOURS


Minot MTBM TREND PLOT
73KA - **control unit avionics (QPA=3)
x TYPE 1. "INHERENT"
• TYPE 6. "NO DEFECT"
1983
PREDICTED TYPE 1
3 MONTH AVG
AS OF APRIL 83
MTBM
(3-month moving average - hours)
CUMULATIVE FLIGHT HOURS

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Larry K. Bock was born on 20 March 1950 in Clarksville, Arkansas. He graduated from high school in Clarksville in 1968 and attended the College of the Ozarks there, graduating in May 1972 and receiving the degree of Bachelor of Science in Mathematics. Upon graduation, he enlisted his commission in December 1972. He completed navigator training a year later at Mather AFB in Sacramento, California. He served as a C-130 navigator at Dyess AFB in Abilene, Texas and at Rhein-Main, Germany, followed by a tour in Headquarters, USAFE at Ramstein AB. He entered the school of Systems and Logistics of the Air Force Institute of Technology Air University in June 1982.

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